

REPORT DOCUMENTATION PAGE

AFRL-SR-BL-TR-02-

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering the required data, reviewing the collected data, completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE January 7, 2002		3. REPORT TYPE A Final Technical Report. 10/1/1994 - 2/28/00	
4. TITLE AND SUBTITLE The Stanford University US-Japan Technology Management Center				5. FUNDING NUMBERS Grant No. F49620-94-1-0458	
6. AUTHOR(S) Richard B. Dasher, Director, US-Japan Technology Management Center					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) US-Japan Technology Management Center Stanford University 430 Sherman Avenue, #312 Palo Alto, CA 94306				8. PERFORMING ORGANIZATION REPORT NUMBER Grant No. F49620-94-1-0458	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) AIR FORCE OFFICE OF SCIENTIFIC RESEARCH/PA 110 Duncan Avenue, Suite B115 Bolling Air Force Base Washington D.C. 20332-0001					
11. SUPPLEMENTARY NOTES					
12a. DISTRIBUTION / AVAILABILITY STATEMENT No restrictions				12b. DISTRIBUTION CODE AIR FORCE OFFICE OF SCIENTIFIC RESEARCH (AFOSR) NOTICE OF TRANSMITTAL DTC. THIS TECHNICAL REPORT HAS BEEN REVIEWED AND IS APPROVED FOR PUBLIC RELEASE LAW AFR 150-12. DISTRIBUTION IS UNLIMITED.	
13. ABSTRACT (Maximum 200 Words) This grant established the US-Japan Technology Management Center, Stanford University School of Engineering, as an ongoing center of excellence for the study of emerging trends and interrelationships between technology R&D and industry strategies in Japan. Our research, university education, and public outreach programs during and after the grant term focused on defense-relevant technologies, such as optoelectronics, advanced computing and networking, nanotechnologies, MEMS, system-level chip integration, and advanced manufacturing. Our technology management focus embraced industry standards and standardization, intellectual property management, U.S.-Japan joint ventures, Japanese science and technology policy, and university-industry relations. Several thousand U.S. technology managers, researchers, and company executives participated in our public programs. These included employees of U.S. national labs, military, and other U.S. government personnel, as well as key persons from major defense contractors and the Silicon Valley high-tech community. Our new Internet websites, including <i>Japan Window</i> and our ongoing <i>J Guide</i> Internet directory of Japan information, reached an estimated 137,000 unique individual users. In addition, our success in obtaining outyear funding to continue our programs so far is an indication of (a) our success in meeting the goals of the grant and (b) the validity and value of the JITMT goals for its U.S. target audiences.					
14. SUBJECT TERMS Japan • Technology Management • Advanced Computing • Internet • Optoelectronics • Flat Panel Displays • Information Technology • Machine Translation • Nanotechnologies • Technical Translation • Industrial Standards • Engineering Curriculum				15. NUMBER OF PAGES 66	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL		

20020130 258

FINAL TECHNICAL REPORT

Submitted to the

U.S. Air Force Office of Scientific Research

U.S.-Japan Industry and Technology Management Training Program

By the Grantee:

**Stanford University
US-Japan Technology Management Center**

Grant Number F49620-94-1-0458

October 1, 1994 – February 28, 2000

**Dr. James S. Harris, Principal Investigator
Dr. Richard B. Dasher, USJTMC Director**

**rdasher@stanford.edu
CIS Building
Stanford, CA 94305-4070**

Table of Contents

- 1.0 Executive Summary
- 2.0 Education
 - 2.1 Seminars
 - 2.2 "Japanese Business Culture"
 - 2.3 "Working with the Japanese"
 - 2.4 "Reading Technical Japanese" Language
 - 2.5 Other Contributions and Graduate Placement
- 3.0 Research Programs
 - 3.1 Studies of Japanese Technology Management
 - 3.1.1 Japanese-Driven International Research Collaborations
 - 3.1.2 Flat Panel Display Manufacturing
 - 3.1.3 Other Study of Advanced Technology Management
 - 3.2 Ongoing Trends Analysis of Selected Technology Areas
 - 3.3 Development of Electronic Information Technologies for Distribution of Japan Information
 - 3.3.1 Japan Window
 - 3.3.2 Prototype Website of the National Diet of Japan House of Councillors
 - 3.3.3 Dissemination of Micromachine Center Information
 - 3.3.4 The Stanford "J Guide" to Online Japan Information Resources
 - 3.3.5 "Converter Plus"
 - 3.3.6 Machine Translation System Benchmarking and Applications
- 4.0 Outreach
 - 4.1 Public Programs
 - 4.2 Publications and Presentations
 - 4.3 Internet Websites
- 5.0 Cooperation with Other Centers
 - 5.1 Video Presentation of the JITMT Program
 - 5.2 Lunchtime Presentations in Washington, D.C.

6.0 Recommendations

7.0 Appendices

A. Seminar Series Schedules

B. T.V. Conferences (Programs, schedules, press coverage)

C. Other Conference Programs

Joint Program with Japan Society of Northern California, September 1999

Japan's NII

D. Books of Proceedings & Supplementary Materials

Technology Standards & Standardization Processes

Optoelectronics Research in Japan and the U.S.

Flat Panel Displays: Views from the U.S. and Japan

Japan's NII (binder materials)

E. Copies of Representative Publications

Jguide : a publication in the AsianDOC Electronic Newsletter

Manufacturing Cost of AM-LCDs

Optical Interconnect and Optical Logic R & D in Japan

The Development of Laser Diodes at Sony

Japan Window, a US-Japan Internet-based collaboration

Stanford University
US-Japan Technology Management Center
Dr. James S. Harris, Principal Investigator
Dr. Richard B. Dasher, Program Director

Final Technical Report

Grant Number F49620-94-1-0458

1.0 Executive Summary

The referenced grant was a renewal grant in the U.S.-Japan Industry and Technology Management Training Program (JITMT). It was awarded in 1994 to the US-Japan Technology Management Center (USJTMC), which is organizationally located in the School of Engineering, Stanford University, on the basis of a nationwide competition and review of our previous work. (The USJTMC was created in 1992 with funding from an earlier JITMT grant, number F49620-92-J-0538). The original term of the current grant was 1 October 1994 through 30 September 1997, but several with-cost and no-cost extensions allowed us to continue our grant activities through 28 February 2000.

Under the referenced grant, the USJTMC has successfully achieved the major goals outlined by the JITMT grant program. We completed the process of establishing the USJTMC as an ongoing, nationally- and internationally-recognized center of excellence for the study of Japanese advanced technology research trends and technology management practices. With constant attention to the changing nature of the U.S.-Japan relationship in security, technology, business, culture, and education, our emphasis has been on the close and complex nature of the research, product design, and organizational culture for innovation and adaptation to change. Our research projects have yielded analyses of Japanese research and industry trends in optoelectronics, flat panel displays, nanotechnologies, IC packaging, system-on-chip integration, and other advanced technology areas. Our public lectures, university seminars, and conferences have become an actively utilized Silicon Valley forum in which industry and national laboratory researchers and technology managers come together with Stanford University experts and students to learn about and discuss Japanese and East Asian technologies, technology management practices, and high-technology business and market development trends. Our Internet-based outreach, including the *Japan Window* (now spun out of the University as a non-profit activity) and the *J Guide* to Japan Internet resources (<http://fuji.stanford.edu/jguide>), have reached literally tens of thousands of U.S. educators, experts, and practitioners, providing them with up-to-date

information about Japanese technologies, high-tech business trends, and related issues in a usable, understandable format for American audiences.

A few representative highlights of particular successes in our programs that received support from the grant include:

- First public presentation in the U.S. by a major new Japanese university-industry research consortium on IC packaging of their goals and research methodology
- First public demonstrations in the U.S. of prototype LCD devices by Japanese companies
- On-site public reporting from trade shows and conferences in Japan by U.S. analysts via TV conference to Stanford (and, via closed-circuit retransmission, throughout the U.S.)
- Big-picture overviews of semiconductor, electronics, and other advanced technologies and technology strategies by Japanese industry leaders, delivered in public forums and via publication
- Early development of Internet resources that led the USJTMC to be called "a crucial resource for any U.S. firm dealing with Japan" (*PC Computing* magazine, "Roadmap to the Internet," December 1995)
- Placement of student research assistants after graduation in jobs in U.S. companies that capitalize on their Japan-related expertise, e.g. a licensing engineer at Dolby Laboratories, a sales engineer at the Japan subsidiary of Teradyne (an American semiconductor testing equipment maker), a software localization expert at Filemaker, etc.
- The establishment of productive relationships with Japanese government and industry partners (sources of information) and also with sponsors of outyear support for some of our programs.

The grant enabled the USJTMC to map numerous threads of cooperation and competition within the R&D communities of Japanese government and industry. Themes for analysis have included industry standards and standardization processes; intellectual property systems and their exploitation; and training, beliefs, and locational technology leadership structures. The USJTMC investigated best practices in U.S.-Japan technology-based joint alliances, and structural and dynamic change in Japanese R&D management practices. With those threads we have connected many ideas with the

proper context that is necessary for U.S. audiences to understand and evaluate ongoing trends. Our methodologies included close cooperation with human sources of primary information and data (researchers and executives of Japanese research programs, consortia, and companies, and also relevant Japanese and U.S. government officials) as well as information and data from Japanese-language and also U.S. trade publications, corporate-internal publications ("gray literature"), and other non-covert sources. For example, by partnering with several Japanese organizations, we brought information to U.S. audiences via real-time two-way TV conferences with sites in Japan. On the Internet World Wide Web, we published formal papers and disseminated presentation materials by experts who provided us with analyses of Japanese R&D trends, S&T policy, government funding dynamics, etc.

During the grant period, we kept pace with major changes in the nature of the U.S.-Japan science and technology relationship. At the outset of the grant, U.S. concerns centered on uncertainties and lack of understanding about Japanese efforts and strategies in regard to S&T economic and security issues in a post-Cold War world. At present, major U.S. concerns center on improving mutually beneficial U.S.-Japan cooperation for the purposes of defense preparedness, innovation, Internet security, terrorism, economic development assistance, education, and inter-organizational conflict resolution. While much of the U.S.-Japan science and technology relationship has come to focus on private-sector concerns such as competitiveness, there is a close relationship between these concerns and defense preparedness. Our areas of technology focus have consistently centered on technologies that are cited as core technologies by AFOSR, including optoelectronics, nanotechnologies, advanced materials, IC packaging, and others.

One aspect of the abovementioned change is that information about Japanese science and technology became much more accessible during the grant period, thanks also to the Internet World Wide Web and commercial publishers' response¹, when they found out there was really a market for such information. Nevertheless, a major problem remains: information analysis. Not all information from Japan, even accounts in major publications, is of good quality. Moreover, it still requires a Japan specialist to provide the background explanations that are needed in order to evaluate the reliability

¹ (e.g. the appearance of the monthly high-tech industry trade magazine "J@pan Inc", which began as "Computing Japan" in about 1996).

and to understand the significance of most news coming out of Japan. In addition, there is still a continuing need for better Japanese language education in science and technology areas, especially in regard to applied research and product development. While important basic research from Japan tends to reach international, English-language publications in a timely way, our ongoing monitoring of Japanese-language trade and technical publications indicates that news and technical reports of a more applied or engineering nature are still typically published in Japanese up to a year before they appear in English.

Nevertheless, while we judge our overall results to be a resounding success, the uncertainty of the funding during the post-award grant term had a negative impact on our ability to conduct in-depth long-range projects, especially Ph.D.-level research. For example, reductions in the nationwide JITMT budget caused our third-year funding to be reduced from a negotiated award option of approx. \$890,000 to an actual award of \$160,000. The continued uncertainty of JITMT funding, along with our realization that outyear support would come primarily from commercial sources, compelled us to refocus our programs (a) to shorter-term projects, (b) to themes that are of immediate interest to industry, and (c) to broader East Asia regional issues beyond Japan. Moreover, the bulk of our outyear support so far has come from Japanese and other East Asia sources, not from the U.S. (government or industry). Consequently, although our goal continues to be to provide valuable resources to U.S. audiences both inside and outside Stanford University, we currently have only limited, discretionary resources with which we can address strategic technology questions and U.S. human resource development issues that are of national (as opposed to commercial) importance to DoD and other U.S. government planners. Furthermore, it is uncertain how long we will be able to continue to offer some of educational programs, e.g. the Technical Japanese Language classes.

At present, major structural changes are underway in Japan's cross-sector (government-university-industry) innovation systems for high technology R&D. These include greater emphasis on joint university-industry work, public sector funding support for business incubation and university IP rights licensing; quasi-privatization of national universities and national labs; and changes in regulatory frameworks governing IP ownership. The portfolios of all the Japanese government ministries are in flux. Japanese government funding mechanisms for R&D are undergoing a shift from long-term "battleship" type national projects (10 year terms, often totaling over \$200

million per project, with research agendas and grantees set in advance) to shorter term (typically 5 years), smaller, competition-based, more flexible project structures. These changes have not yet had a major impact, due to the inertia of the present model. But, they have good possibilities for improving the efficiency and productivity of Japan's R&D and its innovation systems. Consequently, we see an ongoing need for programs such as those that we have initiated via the referenced grant. The outlook for funding for a university-based center such as the USJTMC is extremely challenging, but we are committed to continue our efforts to deliver up-to-the-minute analyses to present and future generations of U.S. technology managers and researchers, and also to serve as a resource for them in meeting the various challenges of cooperation and competition with Japan in an era of globalization of R&D as well as business.

2.0 Education

This section describes courses and seminars developed and funded by the USJTMC with support from the referenced grant. This section only addresses courses that were available for credit to registered Stanford University students. Some of these events were additionally publicized to the Bay Area industrial and national laboratory communities as open, public outreach activities (but with no university credit). Other outreach activities (which were not available for university credit to anyone, including university students), are described in Section 4 below.

Courses we presented in Stanford University's regular, for-credit curriculum included:

- Seminars in Japanese Technology Management (EE-392R, autumn and spring quarters), subsequently divided into
 - Topics in International Technology Management (EE-402a, autumn)
 - Topics in International Advanced Technology Research (EE-402s, spring)
- Japanese Business Culture (AL-051/151, winter quarter)
- Reading Technical Japanese (ALJ-130, summer quarter)

In addition, in cooperation with Stanford's Continuing Studies Program, the USJTMC delivered an extension division course, "Working with the Japanese" (CSP-Bus 003) from 1994-97 that was based around the content of the "Japanese Business Culture"

course. These courses and the recent job placement records of the Center's graduate research assistants entering the labor market during the current grant year are discussed in detail below.

2.1 Seminar Series

The USJTMC began the current grant term with a major reorganization of the seminar series on Japanese Technology Management that we had begun under our previous JITMT grant. Under the current grant, beginning with the Spring 1995 offering (subtitled "Flat Panel Display Technologies: Views from the U.S. and Japan"), we focused each offering of the series on a different, specific topic. We subsequently formalized two different tracks for the series: in the autumn quarters we focused on topics in international technology management, and in the spring quarters we focused on surveys of advanced research in selected technology topics. While we continued to emphasize Japanese efforts in all of our series, we included some presentations from U.S. and East Asian sources as benchmarks. Each quarter's offering of these series thus consisted of a new set of presentations with different speakers and different content. As before, the series continued to include a ten-week offering of lecture-presentations and Q&A by a distinguished guest speaker from industry, government, or the academic community.

Beginning with the 1994-95 academic year, both the autumn and spring quarter seminar series were planned and coordinated by the USJTMC Director, Dr. Richard Dasher. A graduate student served as course assistant, and USJTMC staff conducted publicity/outreach and logistics coordination with the guest speakers and their sponsoring organizations. Funds under the JITMT grant went to cover the costs of planning, presenting, and publicizing the two series. All of the guest speakers donated their time and effort and supported their own travel expenses. In addition, from 1994-95, the USJTMC also began to successfully obtain small, unrestricted gifts from industry associations and individual companies in support of these seminar series and our other programs.

As noted above, the series were available to all registered students for university credit. In addition to on-campus participation, the seminars were broadcast via the Stanford Instructional Television Network (SITN) to registered students in their 200+ member companies in the San Francisco Bay Area. This also included distribution via videotape to SITN's remote member companies elsewhere in the U.S. Many companies

officially registered their employees through SITN to receive university credit for the series, and SITN also allowed these seminars to be viewed by non-registered persons. From the autumn 1999 series, SITN additionally began to disseminate these series by means of streaming video on the "Stanford On-Line" website; the sessions were made available to nonregistered viewers as well as registered students. Also from autumn 1994, we initiated a more concentrated publicity effort to encourage participation in the series by persons outside the University community. Our publicity channels included email announcements, posted flyers, and newspaper advertisements.

As a result, these seminar series have come to attract increasing numbers of attendees both from the university community and from local industry and national laboratories. Registrations rose from an average of 50 students per offering in 1994 to about 80 students for the autumn 2000 offering. Attendance at the auditorium always averaged double the number of registered students, so that by year 2000 we were attracting about 150 to 175 participants to each session. Sessions with particularly well-known speakers (e.g. Dr. Yoshio Nishi of Texas Instruments or Mr. Aki Yoshikawa, President of NTT DoCoMo USA) attracted over 250 persons. We do not have definite statistics on the size of the TV or Stanford On-Line audiences, but based on accesses to the archived presentation materials on our website, we estimate that the series content reached over 1,000 persons per offering by the end of the grant term.

Below are the topics addressed by each offering of the two series since 1994:

Autumn: Topics in International Technology Management

- 2001 High Tech Entrepreneurship and Innovation in East Asia
- 2000 Internet Access Modes and E-Commerce in East Asia
- 1999 The Transformation of R&D in East Asia and Japan
- 1998 Technology Standards and Standardization Processes
- 1997 Joint U.S.-Japan Alliances for R&D:
Engineering Cooperation for Competitiveness
- 1996 Intellectual Properties in the U.S. and Japan:
What the Researcher Needs to Know
- 1995 Strategic Alliances and Technology Flow
- 1994 Japanese Technology Management

Spring: Topics in International Advanced Technology Research

- 2001 Wafer-Level Technologies for Advanced IC Design
- 2000 Photonics-Electronics Integration:
International Perspectives into Advanced Technology Trends
- 1999 System-on-Chip
- 1998 Semiconductor Packaging and Interconnects:
International Trends and Applications
- 1997 Nanotechnologies and Micromachining:
Japan and the U.S.
- 1996 Optoelectronics Research in Japan and the US
- 1995 Flat Panel Displays: Views from the U.S. and Japan

We present more details about these offerings on the following pages.

Autumn 1994

As noted above, in autumn 1994 we maintained the orientation toward general issues in Japanese technology management. Below are some of the highlights of the Autumn 1994 series:

- Dr. James Martin, Director, Rockwell International Science Center Palo Alto Lab and chair, National Research Council study group on civilian competitiveness with Japan, discussed areas of emerging competitive strength in Japanese industries and new paradigms of government-university research collaboration in Japan.
- Dr. Hiroyuki Mizuno, Senior Executive Vice President, Matsushita group, provided first-hand insights into how Japan was able to catch up so quickly to the U.S. in consumer electronics technologies.
- Dr. Keith Bennett, former managing director of Newport Corporation's Japanese subsidiary, discussed technology transfer issues in negotiating technology licensing agreements in the Japanese market.
- Mr. Gary Rieschel, then Vice President (Asia Pacific), nCUBE Corp., pointed out strengths and dangers in different types of strategic alliances with Japanese partners in light of Japanese market dynamics.

- Mr. Scott Johnston, then of Stanford's Graduate School of Business, discussed his work in a NIST-sponsored study of massively parallel computing research in Japan, with focus on the benefits sought by Japanese corporations that participated in relevant MITI-sponsored research consortia.
- Ms. Derrel DePasse, then Vice President of Worldwide Government Relations, Varian Corp., discussed Japanese efforts to reduce regulatory barriers in telecommunications and medical technology.

A full list of the presentations in this series and all other series appears in the Appendix to this report

Spring 1995

For the 1995 spring quarter series, we initiated a major new approach, engaging a series of speakers to address an integrated sequence of topics around a single theme. For this first theme-specific series, we focused on Japanese efforts, industry and market conditions, and advanced technology research related to Flat Panel Displays. We adopted the new theme-specific approach for the following reasons:

- To increase U.S. awareness and knowledge of Japanese research efforts in select advanced technology fields,
- To increase the depth of the content provided by each series in regard to strategic technology management practices,
- To integrate our research into Japanese technology trends and technology management with our education and outreach programs in a real-time way, and
 - To encourage repeat participation in subsequent series by students and other attendees.

In the spring 1995 series, our guest speakers presented a cohesive sequence of sessions around the theme "Flat Panel Displays: Views from the U.S. and Japan." FPD technologies were one of the Center's stated areas of research interest under the JITMT grant. This seminar series thus integrated our monitoring of Japanese efforts in these technologies along with our efforts to provide key U.S. audiences with up-to-date information and analysis of Japanese research trends.

Highlights of this series included:

- Overviews of the Japanese FPD industry, its areas of technological and market strength, its trends, and the structure of its R&D base (separate presentations by **Dr. William O'Mara**, President, O'Mara and Associates, and **Dr. Hiroyuki Mizuno**, Distinguished Advisor, Matsushita group)
- An overview of the worldwide state-of-the-art of thin-film transistor (TFT) technologies and their applications (**Dr. Yue Kuo** of IBM)
- U.S. - Japanese success stories in FPD-related industries (separate presentations by **Mr. Norm Turner**, Executive Vice President, Applied Komatsu Technologies (a joint venture of Applied Materials and Komatsu); and **Mr. Peter Goebel**, Chief Operating Officer, Ulvac Technologies)
- A live report via TV conference on the April 1995 Electronics Display Forum in Yokohama, Japan (by **Dr. Mark Hartney**, ARPA/ESTO)
- Discussions of the comparative merits of possible leapfrog technologies (beyond Japan-dominated AM-LCDs), e.g. Field Emitter Displays (presentation by **ColorRay Inc.**) and Electroluminescent Displays (by **Planar Systems**),
- Demonstration of a prototype large-size (21") AM-LCD (by **Sharp Corp.**).

The USJTMTC was able to supplement JITMT support with a gift from the U.S. Display Consortium, which allowed us to print and distribute hard-copy proceedings of the Spring 1995 series. We distributed over 1,200 copies to key contacts in U.S. organizations.

Autumn 1995

In autumn 1995, we focused the series on the topic "Strategic Alliances and Technology Flow," a perennial concern of U.S. firms and researchers who engage in cooperative efforts with Japanese counterparts. This series began with **Dr. Marius Vassiliou**, Rockwell International Science Center, discussing quantitative measurements of technology flow. The series then presented representative case studies of technology

transfer in a variety of frameworks² in electronics, computer, and other high-technology sectors. The autumn series also included two presentations on the impact of new information technologies on technology transfer by Mr. Regis McKenna, Chairman of Regis McKenna Group, and Mr. Howard Rheingold, Founding Executive Editor, HotWired. Other speakers included Mr. Aki Uyetani, CEO of Fuji-Xerox Palo Alto Laboratories; Mr. Atsushi Yamazaki, Director, Nihon Sun Microsystems U.S. Office; Dr. Hiroyuki Mizuno, Distinguished Technology Advisor, Matsushita Electric Industrial Co. Ltd.; and Mr. Yoshio Kurebayashi, Senior Vice President, NTT America.

Spring 1996

The Spring 1996 series provided an organized overview of the defense-critical technology area of optoelectronics. We placed focus onto the present-day situation and future directions of research, with emphasis on Japanese efforts. Corresponding information from the U.S. was provided as a baseline for benchmarking. The individual presentations addressed major government and industry funding projects, directions of research, industry dynamics, and a representative sampling of important new research results. The optoelectronics series began with an introduction to the U.S.-Japan Joint Optoelectronics Project by Dr. Arpad Bergh, President of the Optoelectronics Industry Development Association (OIDA), the major U.S. industry association in for optoelectronics. Dr. Berg's presentation was followed by overviews of U.S. and Japanese optoelectronics industries and markets by Dr. Mitch Halpern (SRI International) and Dr. Hiroyuki Mizuno (Matsushita Electric), respectively. Subsequent presentations described corresponding U.S. and Japanese efforts in particular technologies, such as photonic transport networks and optical computing, and major optoelectronics research projects.

Several presentations in the optoelectronics series deserve special mention. On April 25, 1996, Prof. Joseph Goodman (Electrical Engineering, Stanford University) reported to our audience at Stanford on the content of the *Optical Computing '96* conference held in Sendai, Japan, by means of a live, two-way videoconference from that city less than twenty-four hours after the conclusion of the conference. On May 30, Dr. Shuji Nakamura of Nichia Chemicals demonstrated and discussed his recent successes in developing blue-colored LEDs and laser diodes. Other notable speakers included Dr.

² E.g. distribution licensing agreements, joint ventures, Japanese government-funded consortia, and business-group internal mechanisms.

Junichi Shimada, Director of the Real World Computing Program (a ten-year MITI effort in which optoelectronics comprises a specified area of focus) and Mr. Koji Matsukura, Executive Director of the Japanese industry association for optoelectronics, namely the Optoelectronics Industries and Technology Development Association (OITDA).

Registered students in the optoelectronics series included employees of Sandia National Laboratory and major defense contractors and vendors, e.g. Advanced Microdevices, Adobe Systems, Apple Computer, IBM, Lam Research, Lockheed Martin, National Semiconductor, and Sun Microsystems, just to name a few. Most of these students participated via television. (Nonregistered) visitors who came to the auditorium to see the series similarly included employees of Lawrence Livermore National Laboratory, the NASA Ames Research Center, and a number of other Silicon Valley companies.

As with all of our series, funds from the referenced grant were leveraged by speakers' support for their own travel expenses and willingness to donate their time and efforts without being paid honoraria. In addition, the USJTCM obtained gifts in general support of our Center's activities by the U.S. and Japanese industry associations for optoelectronics (the OIDA and the OITDA, respectively) and by the California liaison office of the Semiconductor Users Committee (UCOM) of the Electronic Industries Association of Japan (EIAJ).

We used these non-grant funds in part to prepare and distribute hard-copy proceedings of the optoelectronics series. Our recipient list for the proceedings included military and other U.S. government offices that were recommended by AFOSR, in addition to our own contacts in companies and national labs. In addition, Stanford separately licensed the series for television rebroadcast at the Lawrence Livermore National Laboratory's closed TV network in summer 1996.

Autumn 1996

The 1996 Autumn Seminar series "Intellectual Properties in the U.S. and Japan: What the Researcher Needs to Know" featured patenting, strategies, human resource issues, patent information access, and copyright systems. In addition to background presentations on IP systems and patent writing, highlights of this series included presentations such as:

- Mr. Takaharu Nakashima, International Development Director, MicroPatent, ("Accessing and using Japanese patent information").
- Dr. Michael Rostoker, President of Microelectronics Research, Inc., and a licensed attorney ("Japanese company attitudes and strategies for patent protection and litigation")
- Dr. Phyllis Genther-Yoshida, Director, Japan Technology program, U.S. Department of Commerce ("U.S. government resources about Japanese intellectual property and IP regulation")
- Mr. Eric Johnston, then a reporter with the *Mainichi Daily News* ("Japanese stance toward intellectual property issues in the APEC summit negotiations at that time")
- Dr. Gota Kano, Managing Director, Matsushita Electronics Corporation, ("Intellectual property features of Japanese companies and the possibilities for complementary collaboration between U.S. and Japan")

Spring 1997

The 1997 Spring seminar series "Nanotechnologies and Micromachining in Japan and the U.S." included presentations about several major new research consortia in Japan and the Japanese funding and support mechanisms for nanotechnologies research, as well as topical presentations on MEMS, single electron devices, nano/micro manipulation, and atomic measurement. Highlights include:

- Dr. Richard A. Kiehl, Acting Professor of Electrical Engineering, Stanford (and formerly a research scientist in the Exploratory Devices Laboratory, Fujitsu Ltd.), presented a detailed analysis of scientific trends and funding relationships in nanoelectronics research, with an emphasis on the funding patterns in Japanese nano-related research.
- Dr. Yoshihisa Yamamoto, Professor of Applied Physics and Electrical Engineering, Stanford (and formerly a scientist with NTT Advanced Technology Laboratories), gave an overview of his "ERATO Quantum Fluctuation Project." sponsored by the Japanese government.

- Dr. Eiichi Maruyama, Project Leader of the Joint Center for Atom Technologies (JRCAT), presented details of the Atom Technology Project including budgetary details and goals for the 10-year Japanese government-funded project. We believe this was the first public presentation on the Atom Technology Project in the United States.
- Dr. Shojiro Asai, General Manager, Hitachi Advanced Research Laboratory, Hitachi Ltd., detailed MEMS- and nanotechnology-related research activities at Hitachi's Advanced Research Laboratory. This coincided with the bi-annual meeting of the advisory committee of Stanford's Center for Integrated Systems, and CIS representatives from U.S. high-tech firms such as Intel, AMD, National Semiconductor, and others attended this lecture as special guests.
- Dr. Tomomasa Sato, Professor, Research Center for Advanced Science and Technology (RCAST) at the University of Tokyo, presented his work on single-atom manipulation. This presentation was broadcast by live videoconference from Japan.
- Dr. Hideki Hasegawa, Professor and Director, Research Center for Interface Quantum Electronics, Hokkaido University, spoke on a new Ministry of Education-funded Japanese multi-university research consortium on nanoelectronics.
- Dr. Katsuhiko Matsumoto, Electro-Technical Laboratory (ETL), spoke on his work into single electron devices and their fabrication at this Japanese national laboratory.

Autumn 1997

The seminar series "U.S.-Japan Joint Alliances for R&D: Engineering Cooperation for Competitiveness" included presentations on wireless communication chips, low power chips, chip specific alliances, and technology transfer issues. Highlights:

- Ms. Junko Matsubara, Senior Analyst, DataQuest, and Dr. Richard Dasher, USJTMC director, shared a presentation on trends in strategic alliances for research and development with Ms. Matsubara providing a detailed analysis of U.S.-Japan alliances in the semiconductor industry.

- Dr. Raj Parekh, Vice President, Sun Microelectronics, recounted the joint development of a low power Java processor chip by Sun Microsystems and Toshiba. Of particular interest were his comments on successful management of cross-cultural product development teams.
- Dr. Masao Kato, Chairman & CEO, Fuji-Xerox Palo Alto Laboratory, discussed Fuji-Xerox as a successful long-term joint venture and also the new Fuji-Xerox Palo Alto Laboratory.
- Dr. David Lyon, Founder, Pacific Communications Science (PCS), Inc., discussed successful partnering by U.S. start-up companies with established Japanese firms based on the case study of PCS' role in the development of the Japanese PHS ("personal handyphone") microcellular technologies and markets.
- Mr. Tsutomu Maruyama, General Manager for the Display Business Unit, IBM-Japan, gave details about the joint venture for display technology between IBM and Toshiba, which resulted in a new reflective LCD projector. In the course of the talk, Mr. Maruyama and his associates gave the first public demonstration of this prototype in the U.S.
- In one of our first presentations about East Asia trends outside Japan, Mr. Barry Burgdorf, General Counsel, Samsung Austin Semiconductor, discussed the collaborative effort between Samsung and Intel to develop chips for consumer electronics.

Spring 1998

The 1998 Spring seminar series "Semiconductor Packaging and Interconnects: International Trends and Applications" included presentations on electronic and also photonic packaging, on-chip interconnects, digital system architecture, and advanced microsystems integration. A particular highlight of this series was the first public presentation in the U.S. of a new Japanese university-industry consortium on advanced microsystems integration; see below. Series highlights included:

- Dr. Suhas Patil, Chairman Emeritus, Cirrus Logic, gave an introductory lecture on the interdependence of digital system architecture and interconnect technology.

- Dr. Yoshio Nishi, Senior Vice President and Director of Semiconductor Research and Development, Texas Instruments, gave an international perspective into the present and future of on-chip interconnects.
- Mr. Kazuaki Utsumi, General Manager, Material Development Center, NEC Corporation, gave an overview of NEC's research and interests in advanced packaging technologies.
- Mr. Fuminori Ishitsuka, Senior Research Engineer, NTT Optoelectronics Labs, presented materials about high-frequency packaging for Opto-Electronic devices and microwave/millimeter-wave devices.
- Mr. Takao Fujitsu, Senior Manager, Semiconductor Group, Toshiba Corporation, spoke in his role as President (COO) of the Institute for Advanced Microsystem Integration (IMSI). The USJTMC seminar was the first venue in the U.S. that presented details about this newly founded university-industry research consortium in Japan. This information later served as the basis for a news article in the U.S. industry magazine *Chip Scale Review*.
- Dr. Solomon Beilin, R&D Manager, Fujitsu Computer Packaging Technologies, Inc., gave a presentation about Fujitsu's research into advanced IC packaging.

This series was rounded out by a Stanford Faculty Panel that featured Professors **William Dally**, **David Miller**, **Krishna Saraswat**, and **Simon Wong** (all **Electrical Engineering**). They spoke about new architectures and challenges for IC design and fabrication posed by scaling and interconnect-related issues, and provided an overview of international efforts in these areas.

Autumn 1998

The seminar series "Technology Standards and Standardization Processes" emphasized the importance of participation in the setting of industry standards as a process that becomes increasingly crucial to international success in markets dominated by rapid technology developments. In addition, the series included case study presentations on standards in arenas such as broadband communications (DSL), memory chips, Java-related software and hardware, and third generation mobile wireless communications.

- Dr. Robert Hebner, Acting Deputy Director, NIST (National Institute of Standards and Technology), gave a talk on the role of standards in technology development and international competitiveness.
- Mr. Bukasa Tshilombo, Senior Analyst and Program Manager, Mobile Communications Division, DataQuest, gave an in depth analysis of the dynamics of then-ongoing negotiations toward standards for third generation mobile wireless communications networks (IMT-2000). At the time, Japan had moved ahead of other advanced economies in deciding on a standard in this area.
- Dr. Desi Rhoden, Fellow, VLSI Technology Inc., and Chairman, Board of Directors, Joint Electronic Devices Engineering Council (JEDEC), spoke on the efforts by that standards-setting organization to reduce the time required in a standardization process and also to disseminate standards information by means of the Internet.
- Prof. John Cioffi, Stanford University, and founder of Amati Corp., discussed the international negotiations in regard to next-generation DSL standards.
- Dr. Hideo Setoya, Executive Director, Association of Super-Advanced Electronics Technologies (ASET), spoke on the role of Japanese R&D consortia in standards-setting.
- Dr. Ryoiku Toge, Vice President, International Electrotechnical Commission (IEC), and Standards Chairman, Electronic Industry of Japan (EIAJ) gave an update on recent activities of the IEC and EIAJ.
- Dr. Farhad Tabrizi, CEO, SLDRAM Inc., Director, Strategic Marketing, Hyundai Electronics, gave a talk on Next Generation Memory Devices.

The series concluded with a keynote presentation by Dr. Geoffrey Moore, well-known author of *Crossing the Chasm*, *Inside the Tornado*, and other books about high tech market and business development. Dr. Moore spoke on the implications of companies pushing for proprietary, *de facto* standards (e.g. Microsoft Windows) and differences between the U.S. and Japan in regard to processes of standardization.

The autumn 1998 series also marked the USJTMC's first successful development of supplementary funding that actually exceeded the amount of JITMT funds allocated

to a particular activity. The USJTMTC obtained grants in support of this series from the National Institute of Science and Technology (NIST), and the Japan External Trade Organization (JETRO). In addition to stretching our JITMT funds, these supplementary grants enabled us to prepare, print, and distribute a hard-copy book of proceedings. This was a major step in our progress toward developing sufficient outyear support to continue our programs beyond the term of the JITMT grant.

Spring 1999

Our seminar series "System-on-Chip"(SoC) included presentations on Japanese company strategies related to highly integrated ICs, technical and also technology management challenges related to SoC, and also the implications of this technology trend for new industry structures and innovation systems in the chip and electronics industries.

- Mr. I. J. Yamaguchi, Associate Vice President and General Manager, NEC Electronics, Inc., spoke on NEC's vision for system-on-chip technologies.
- Mr. Mark Birnbaum, Director of Strategic Technology at Fujitsu Microelectronics, Inc., gave a talk about the Virtual Socket Interface Alliance (VSIA) and issues related to IPR transfer.
- Mr. Mitsuo Saito, General Manager, System Ultra Large Scale Integration (ULSI) Lab, Toshiba, gave a talk about Toshiba's Approach to System-on-Chip.
- An international panel of representatives from Taiwan Semiconductor Corporation, DataQuest, and the Virtual Component Exchange talked about competing U.S.-Japan efforts to establish marketplaces for IP trading of chip designs.

Autumn 1999

For this last series during the term of the grant, we chose the topic "The Transformation of R & D in East Asia and Japan" in recognition of the major changes in R&D systems that are in progress in Japan and across the region. Presentations included information and case studies about semiconductor R&D, smart computing, advances in Taiwan's R&D, and the changing role of university-industry relations in Japan.

- Dr. Kilnam Chon, Chairman, Asia Pacific Advanced Network (APAN), and Professor, Department of Electrical Engineering and Computer Science, Korea Advanced Institute of Science and Technology, spoke on APAN, a multinational East Asia regional research consortium dedicated to next generation Internet technologies.
- Dr. Harry Tan, Professor, Nanyang University, Singapore, gave a talk on development, policies, and opportunities in the emerging digital economies of Asia.
- Mr. Megumi Takata, Director and chief Operating Officer, Center for Advanced Science and Technology Incubation Ltd. (CASTI) at the University of Tokyo, and Mr. Yutaka Hara, Licensing Associate, Recruit Company Ltd., provided an overview of Japan's new regulatory system for university IPR licensing and an introduction to CASTI as a third-sector technology licensing organization (TLO) dedicated to market Japanese university IPR. . Their presentation and audience discussion was delivered live from Tokyo by two-way TV conference.
- Dr. Irving T. Ho, Chairman of EiC Corporation, who is widely regarded as one of the visionaries behind the Taiwan Hsinchu Science Park, Taiwan's efforts in developing regional S&T and innovation centers similar to Silicon Valley.
- Dr. Gerhard Fasol, President and CEO, Eurotechnology Japan K.K., discussed the changing roles of U.S. and other non-Japanese companies in the R&D world of Japan.
- Dr. Robert Yung, Director and Chief Technologist, Intel China Research Center, gave an overview of Intel's R&D activities in China, with emphasis on what an American company hopes to obtain through such internationalization of its R&D efforts.
- Dr. Katsushiro Shimohigashi, General Manager, Semiconductor Technology Development Division, Semiconductor and Integrated Circuits, Hitachi, Ltd., spoke on the transformation of semiconductor R&D in Japan.

The Autumn 1999 series thus provided a snapshot near the end of the term of the referenced grant of the next-generation of R&D frameworks (innovations systems) that

have begun to emerge in Japan and East Asia. As shown by the lists of seminar series topics early in this section, we have continued to produce new series after the conclusion of the grant by means of other sources of funding. These continue to be highly popular venues for students and industry representatives to meet and network, as well as forums in which to learn about themes that are timely and forward-looking.

As noted, our seminars have aired a number of "first ever" discussions of path breaking research. With the trust of relationships, format, and setting, and the prestige of Stanford's technology community, we were able to obtain priceless information of value from Japan for to students, faculty, and industry visitors. The question and answer sessions indicated a consistently high level of audience understanding and interest. The seminar series also established a community of experts who came together to discuss topics such as intellectual property management, technology transfer, organizational strategies for R&D, and emerging technology trends. They worked at several levels, including the Stanford engineering community, the Silicon Valley visitors, our guest speakers, and others with insights into Japanese science and technology policies as practiced by some of the most closely guarded companies in the world. By connecting them in an academic environment of open inquiry and shared research results, the USJTMC developed a successful pattern of activity. Consequently, we recommend that this type of program be continued within a university framework.

The planning and organization of these seminar series has given the USJTMC unique insights into the patterns of technology development in Japan and the rest of Asia. We have also gained unique experience in successfully packaging and contextualizing this knowledge so that it is meaningful to the current and next generation of key technology managers, researchers, and executives. Future seminar series will cover topics such as nanotechnologies, DNA computing, new patterns of university/industry interaction, and the expansion of Japanese industry throughout Asia. We will continue to seek out emerging topics of importance, e.g. bioterrorism, population aging, regulatory reform, energy and the environment, and the role of Asian business practices worldwide. Underlying these choices is a recurring observation about competition and cooperation: within any system of resource interdependencies, competition and cooperation are inseparable. We have demonstrated a beginning on the methods of inquiry useful for shedding light on such complex practices.

2.2 "Japanese Business Culture"

Because Stanford had several pre-existing programs for students to gain educational and internship experiences in Japan, the USJTMC focused its efforts on providing educational opportunities at Stanford that would increase the value and reduce the risk of failure of these Japan experiences. One of the contributions that resulted from this approach is "Japanese Business Culture" (hereafter "JBC", Asian Languages Dept. courses 051 and 151), which were developed and are taught by USJTMC Director Richard Dasher. During the grant term, the course also came to be cross-listed in Stanford's International Relations and International Policy Studies programs.

In JBC, students apply the study of key sociocultural concepts (such as group dynamics and cultural preferences for indirect communication modes) to the investigation of Japanese corporate organizational structures, decision-making dynamics, innovation and technology management approaches, crisis management techniques, and negotiation strategies. While Dr. Dasher taught most sessions, each year's offering also included one guest lecture. Guest speakers included visiting researchers at Stanford from Toshiba and NEC, who discussed the R&D environment and interpersonal dynamics at their companies, Japanese women executives and specialist consultants on women and minority issues in Japanese business, representatives from JETRO San Francisco and the Consulate General of Japan (San Francisco), board directors from Japanese companies who were briefly visiting Stanford, and technology licensing representatives from Japanese universities. Each year, the course material was updated and revised in keeping with the changing status of Japan's business conditions, corporate restructuring, and cross-sector (government-industry and university-industry) relationships.

JBC enrollments regularly included students who had returned from Stanford's in-Japan programs (notably, the Stanford Center for Technology and Innovation program at the Stanford Japan Center, Kyoto). Course evaluations from these students indicated that they found great value in the intellectual framework provided by JBC; it greatly improved their understanding of their Japan experiences. These students were also called on to share their experiences with the class as appropriate to the topic of study. In addition, JBC soon came to serve as a "gateway" course for students who were considering studying more about Japan and possibly participating in Stanford's in-Japan program. Dr. Dasher worked closely with Stanford's Overseas Studies Program and the

Stanford Japan Center (in Kyoto) in order to continue to tailor the Center-sponsored "Japanese Business Culture" course to the needs of students headed for Japan in the programs administered by those organizations. In addition, the class regularly included several graduate students headed for the NSF Summer Institute in Japan. It also included employees of companies such as AMD, Apple Computer, Cisco Systems, Hewlett-Packard, IBM, SRI International, and Lockheed (space systems), who enrolled as non-matriculated graduate students.

Enrollments in "Japanese Business Culture" increased regularly during the grant term to a high of 38 registered students in Winter 1998. Enrollment then stabilized at a current level of approximately 25 students for each offering. About 35-40% of the students came, on average, from engineering fields, and about the same percentage were students with majors in International Relations or Economics. A number of students went on to apply the knowledge gained in JBC to their jobs after graduation; we have received word from graduates who have gone to work in the Japan subsidiary of Price Waterhouse Coopers, a U.S.-based start-up company doing software localization into Japanese language, and a chip-development joint venture between Toshiba and IBM, to name but a few. One student from the class interned during the following summer as a Wilson Fellow in the Office of the Secretary of Defense, during which time she reported that this course had been very useful in preparing her to participate in a major U.S. cabinet-level visit to Japan. We believe that, as time passes, such graduates will be promoted to more senior strategic positions, in which the value of the knowledge and understanding of Japanese business that they acquired in JBC will become even more obvious. JBC regularly receives outstanding student evaluations. Students have expressed particular praise for its practical focus and real-world evidence of theoretical concepts.

Through teaching JBC, Dr. Dasher also came to be called on to deliver special pre-departure briefings to Stanford students and visiting student groups from other universities, e.g. the National Technological University (satellite-based distance education), who were headed for Japan experiences. In addition, Dr. Dasher spoke about Japanese business practices to conferences such as Stanford's annual "East-Fest" week of events related to East Asia. At the end of the grant term, Dr. Dasher was being called on to serve as faculty advisor to various Stanford student groups, including the Asia-Pacific Student Entrepreneurship Summit (ASES), the Asia Technology Initiative (ATI) internship program, the Stanford Asia-Pacific Technology Group (ATG) student

professional society, and the Stanford chapter of the Alpha Kappa Psi professional business-focused co-ed "fraternity." Dr. Dasher also became a faculty advisor to undergraduates in Stanford's International Relations program, and he supervised several masters students' thesis research in East Asian Studies. In addition, he was one of two faculty readers for a Master's thesis in Computer Science with Distinction in Research, which investigated U.S.-Japan cross-cultural differences in user responses to "virtual world" websites, and he served on the Ph.D. reading committee for a dissertation about the role that telecom deregulation in Japan played in the success of the mobile Internet and cell phone service provider NTT DoCoMo.

2.3 "Working with the Japanese"

From 1994-97 the Stanford Continuing Studies Program separately supported the refocusing and delivery of some of the content of the Japanese Business Culture course into a new extension division course titled "Working with the Japanese" (CSP course BUS-003), which was taught by Dr. Dasher. Each spring, this evening course attracted about 25 participants from U.S. defense contractors, U.S. firms attempting to enter the Japan market, entrepreneurs, venture capital firm representatives, and U.S. employees of local subsidiaries of Japanese firms. The course received outstanding evaluations from the students. Because of the unstable funding situation with the JITMT grant, however, Dr. Dasher had to devote his time more to developing sources of outyear support, and so the course was discontinued after 1997. The USJTMC continued to have a very positive relationship with Stanford's Continuing Studies Program, which on several occasions has expressed interest in revitalizing this course.

2.4 "Reading Technical Japanese" Language

Based on a survey of student needs, the USJTMC had developed a third-year level Japanese language course "Reading Technical Japanese" (hereafter "RTJ," Asian Languages Dept. course 130) during the term of the previous JITMT grant. This course not only provided advanced study of vocabulary and styles of writing that are distinctive in scientific and technical writing, it also focused on oral presentations and related skills that are important for researchers in Japanese R&D settings. The course was developed and taught by Dr. Dasher during the summers, so that it would be accessible to engineering students whose required curricula left little time for language study during the regular academic year.

A distinctive feature of RTJ was that it took new study materials for each offering of the course from articles, advertisements, conference schedules, and other "authentic texts" that had appeared in Japanese technical and trade publications, including corporate-internal publications ("gray literature") less than six months before the course offering. These new materials made up almost the entirety of the course materials for each offering, except for one introductory lesson. Articles for study are drawn from sources such as *Nikkei Electronics*, *Nikkei Computer*, *Optronics*, *Oyo Buturi* ("Applied Physics"), and daily trade newspapers. This allowed for the course to be tailored to the fields of participating students, thereby providing them with an up-to-date view of Japanese technology news in their fields, as well as with relevant vocabulary, grammar, and other language skills. The course thus provided students not only with language-related knowledge, but with information on current trends in key technology areas, such as chip design, software engineering, space science, applied physics, and related topics. Consequently, under the referenced grant, RTJ underwent a major overhaul of its content each year. Under the current grant, the USJTMCM also continued to add features to the course, including a regular weekly Japanese-language discussion forum for students with visiting researchers at Stanford from Japanese companies.

RTJ enrollments, however, were modest: on average about ten students took the course each year. The students came primarily from engineering and natural science fields. In addition, the course was broadcast over the Stanford Instructional Television Network (SITN) to registered students in SITN member-companies as well as being available for participation in the classroom. This was the first offering by SITN of any foreign language course for credit and for a letter grade, and the experiment was judged a success. Students included employees of Hewlett Packard and Cisco Systems, as well as graduate students in various engineering fields. In addition, Dr. Dasher on occasion invited the participation of selected Stanford staff scientists, e.g. Dr. Karl Bane of the Stanford Linear Accelerator Center, who was scheduled to spend six months at the Japanese KEK high-energy physics national laboratory in a cooperative research project.

RTJ regularly received outstanding evaluations from the students. However, because of its small enrollment and the high level of effort required to create new course content for each offering, we have not offered the course since the end of the grant term. (The last offering was Summer 1999.) We have not found sufficient outyear support to cover the costs, and its enrollments were too small for it to receive support from the

Asian Languages Department, which has expressed other priorities for its own limited budget.

2.5 Other Contributions and Graduate Placement

In addition to RTJ, the USJTMC developed and made public an Internet-based self-study resource for technical Japanese language study. This resource was part of our Java-based "Converter-Plus" program, which provided automatic, scrollable calculations of measurement conversions between English and metric measurement systems. "Converter-Plus" introduced the Japanese language vocabulary used for measurements and the names of important measurement units in Japan. This information was delivered both in written form (viewable on any operating system) and in brief sound-files. As a further study aid, the characters used to write the measurement names in Japanese were displayed stroke-by-stroke. The measurement converter and self-study resource were developed by the Center's website coordinator Ayako Yamazaki and (then USJTMC-sponsored graduate student research assistant) Albert So from the Department of Computer Science. "Converter Plus" received prominent praise in the *Los Angeles Times* and was placed in a convenient access point on the America On-Line homepage.

The USJTMC also participated in a number of strategic and working-level groups with faculty representatives from Stanford's Department of Asian Languages, the Center for East Asian Studies, the Overseas Studies Program, and other relevant professors. These groups had two goals (1) improving Stanford's Japanese language courses that are oriented toward science and engineering students, and (2) making Japanese language courses more accessible to Stanford's students in those fields, who have only limited time for in-class language study. This planning was conducted in the context of a university-wide curriculum review initiated by the University's newly formed Foreign Language Division, which coordinates proficiency standards and curricula across the several departments that teach foreign languages.

As noted elsewhere, many students who have participated in USJTMC programs have gone on to positions in U.S. companies that made direct use of their knowledge and experience gained at the USJTMC. A few specific highlights include:

- Adria Anuzis Brown (Ph.D. interdisciplinary technology management, 1995) became a staff research associate at Stanford's Asia-Pacific Research Center.

- Michael Bayle (MS Computer Science, 1995) was a USJTMC graduate student research assistant and one of the founders of our *Japan Window* project. Immediately following graduation, Michael worked as a contractor for Apple Computer, conducting a survey of computer use patterns among Japanese teenagers. Mike subsequently took on business development positions at *PC World* magazine and *Web Magazine*, and he subsequently developed Japan business for the Internet advertising firm Link Exchange.
- Thomas Cunningham (MS Aeronautics and Astronautics, 1995) accepted a position with Xerox International Partners. His work includes frequent travel to Japan as international liaison with individual clients. Tom had worked on machine translation performance benchmarking at the USJTMC.
- Martin Herlihy (MA East Asian Studies, 1995) went to Pacifictech Corporation, a U.S. company in Japan that localizes software for the Japan market. While a research assistant at the USJTMC, Martin had combined his advanced Japanese language skills and computer skills to reorganize and update our *J-Guide* Internet directory of Japan-related websites.
- Gary Brown (MS Electrical Engineering, 1996) joined Dolby Laboratories as a licensing engineer. Gary reported that on his first day at Dolby he was called on to participate in a negotiating session in Japanese with engineers from a company that hoped to license Dolby technology. He regularly traveled to Japan and participated in joint projects with Dolby licensees at Sony, Matsushita, and other Japanese firms.
- Albert So and Junhe Liu (both received MS Computer Science in 1997) went to Netscape Communications in technical positions that were related to Japan market development and product localization.
- Blake Williams (MA East Asian Studies, 1997) took a position doing Japanese-language localization for FileMaker for their FileMaker Pro database products.
- Norman Wayne Karo (MS Electrical Engineering, 1999) went to work in Kumamoto, Japan, doing technical sales for the U.S. semiconductor testing equipment maker Teradyne. At the USJTMC, Wayne had

conducted a major reorganization of our *J Guide* Internet directory, and he had served as teaching assistant for Dr. Dasher's JBC course.

- Derek Poppink (MS Computer Science, with Distinction in Research, 2000) went on to do human-computer interface research at the newly formed Ricoh Silicon Valley Research Center.

Other USJTMC student research assistants continued their graduate study in other programs. These include Burton Lee, one of the founders of the *Japan Window* and a key person in many early USJTMC projects, who went on to obtain the Ph.D. in Mechanical Engineering (2001), with focus on developing on-line remote diagnostic systems for semiconductor manufacturing. Similarly, Elizabeth Ruth Herman (MA East Asian Studies, 1999), is now pursuing the Ph.D. in History with a specialization in Japanese history at Stanford.

After the end of the referenced grant, the USJTMC has continued to support student research assistants in technical and also East Asia Studies related fields, using our outyear sources of support. Our students regularly participate in planning and organizing the EE-402a and 402s seminar series, serve as teaching assistants in JBC, find and organize information from Japan for our *J Guide* Internet directory of Japan information resources, and assist in research on Japanese technology trends analysis and technology management issues (see following section). In addition, after the completion of the JITMT grant, we provided supplemental funding to Stanford from our unrestricted gift funds in support of the tuition of a U.S. Army Foreign Area Officer, Major Frank Clark, in order for him to pursue the MA in East Asia Studies. Maj. Clark received his degree in 2001, with a thesis that focused on Japanese business and government responses to the possibilities of U.S.-Japan cooperation in regard to theater missile defense. These activities demonstrate that the USJTMC has indeed become established as an ongoing education and research center with continuing commitment to the goals of the JITMT program.

3.0 Research Programs

USJTMC research under the referenced grant fell into three types:

- Technology management studies of Japanese innovation systems, including industry and cross-sector R&D consortia and also Japanese

government programs and policies in support of advanced technology research

- Trends analysis of Japanese research in selected advanced technology areas
- Benchmarking and new applications development of electronic information technologies for improved dissemination of Japanese scientific and technical information to U.S. users.

These research activities were distributed across technical areas of focus that included:

- Optoelectronics
- Flat panel displays
- MEMS and micromachining
- Nanotechnologies
- Advanced computing and networking
- Advanced manufacturing technologies (especially those related to the semiconductor industry)
- Machine translation

Our approach stressed the simultaneous integration of research efforts with our education and outreach programs whenever possible. In other words, the USJTMC delivered information and initial analyses of our areas of technology focus to key U.S. government, academic, and industry audiences at the same time as we used that information as input for deeper research analysis. In this way, we were able to gain early insights into emerging trends and up-to-date information about changes in the Japanese policies and patterns of implementation as they began to affect the innovation systems of that country. During the first year of the referenced grant (1994-95), the USJTMC initiated new research programs under the new grant at the same time as we completed other projects under a no-cost extension to our previous JITMT grant. Activities funded under that previous grant are in its final technical report; in the discussion below, we report only on research activities funded by the referenced grant.

As noted elsewhere in this report, the unstable situation with JITMT grant funding was a disincentive to Stanford professors and students from applying these funds to begin long-term projects, such as Ph.D. dissertations. While this situation certainly had a negative effect on the number of academic publications that were

generated by the grant, it nonetheless led us to find new value-added approaches to achieve the research goals of the grant. As is discussed below, we believe that we have indeed achieved those goals. In addition, our ongoing trends analysis have turned out to be of value to new research sponsors. Projects supported by these subsequent sponsors have provided graduate students with support for the literature search phase of their Ph.D. dissertation research in several technical fields, thereby demonstrating an area of value that our approach has for more traditional academic research projects. Our approach to the research under the referenced grant also reflected our understanding that AFOSR priorities for the JITMT program focused more on education and outreach than on research.

3.1 Studies of Japanese Technology Management

Our research in this area focused on Japanese "innovation systems," a term that refers to the entire process from creation of a new idea to implementation of that idea in a new or improved real-world product or service. The innovation system thus typically extends from basic research at a university or national lab to applied research (which may be done at any of various institution-types) to product development, which is typically an activity conducted by a commercial firm. At the beginning of the grant term, Japanese patterns of technology management were considered to present major efficiencies over U.S. patterns. In Japan, distributed information sharing and personnel transfer policies within a vertically integrated corporate group appeared to provide richer networks for connecting various segments of an innovation system than did traditional "linear" technology transfer models, in which an idea is passed from university to corporate research lab to corporate business division lab to the product development division. Moreover, Japanese approaches to technology management encouraged feedback into the innovation system of information and insights from the manufacturing and marketing divisions of a firm. During the course of the grant, however, the continued stagnation of the Japanese economy and the simultaneous success of Silicon Valley led Japanese to question their own approaches to innovation. The Silicon Valley became a model that Japanese policy makers and business persons wished to emulate. Consequently, the USJTMC was able to make contact with many influential persons in Japan who were very interested in the Silicon Valley. Our position thus gave us a remarkable vantage point from which to observe Japan's attempts to introduce into its own institutions some elements of the Silicon Valley innovation system, e.g. robust university-industry technology transfer, a rich environment for start-up company venture financing, entrepreneurship as a respectable career path, etc. By

the end of the grant period, we were observing the introduction of major changes to Japanese innovation systems, including:

- Full or partial privatization of national universities and national laboratories
- New policies of intellectual property ownership for government-funded research results
- A shift in Japanese government support away from "battleship" multi-year, large research consortia that were built on a given set of goals to smaller, shorter-term competitive grant programs with peer review of proposals and results
- The promotion of university-based start-up companies through new policies, new technology licensing organizations, and through the relaxation of prohibitions against faculty conflict of interest
- Corporate attempts to implement deep restructuring of their R&D activities and to dabble in venture investing for strategic technology acquisition.

Many of these changes were just emerging at the close of the referenced grant. In light of Japan's advanced level of science and technology, and the large size of its high technology markets, we see a critical need to devote resources to continuing to study these and other changes and their impacts on the worldwide status of U.S. innovation systems.

3.1.1 Japanese-Driven International Research Collaborations

Early in the term of the referenced grant, we investigated the organizational structure, distribution of labor, and leadership dynamics of international research consortia in which Japan plays a key role. Our interest in this topic grew out of our investigation, conducted under our previous JITMT grant, of the start-up phase of the MITI-sponsored Real World Computing (RWC) program, a ten-year \$200 million effort from 1992 – 2001. Under our current grant, we expanded the scope of our study to include other types of research consortia as well. We focused on the following organizations, which are representative of quite different frameworks for such collaboration: (a) the RWC, (b) the MITI-initiated Intelligent Manufacturing Systems (IMS) program, and (c) the Exploratory Research for Advanced Technology (ERATO) program that was begun by Japan's Science and Technology Agency (now a part of the

Ministry of Education) and continued under the Japan Science at Technology Corporation (JST, itself a merger of two special nonprofit quasi-government organizations).

This study's aim was to provide U.S. organizations with information and analysis on ways in which they can achieve benefits and avoid the pitfalls of participating in such consortia. Moreover, the study aimed to examine the effects that such consortia exert on the direction of research in their technical areas of focus, e.g. optoelectronics, advanced computing and networking, and advanced manufacturing.

The Center already had close contacts with Dr. Junichi Shimada, Director of the RWC. Dr. Shimada had made an overview presentation of the RWC in the seminar during the term of our first JITMT grant. We re-established our contact with him through direct meetings in June 1995, when Dr. Shimada visited Stanford with other Japanese and American members of a delegation of the Joint Optoelectronics Project. Also during 1995, we took initial steps to invite Dr. Shimada for a return presentation with focus on RWC research in optoelectronics.

The Center likewise supported activities at Stanford designed to bring in new information concerning the IMS program. These included a graduate seminar on the IMS program in Stanford's Mechanical Engineering Dept. in autumn 1994 and briefings by delegations from the University of Tokyo, Toyota Motors Corp., and Mitsubishi Electric Corp. in regard to IMS-related research. The Center also sponsored the proposal of Stanford Professor Friedrich Prinz (Department of Mechanical Engineering) to serve on the Academic Coalition for IMS (A-CIMS). Professor Prinz was subsequently selected for this role.

Stanford University is fortunate to be the primary location of a project in the ERATO program, the Quantum Fluctuations Project of Professor Yoshihisa Yamamoto (Department of Electrical Engineering). Dr. Yamamoto joined the Stanford faculty in 1993 from NTT research laboratories. Professor Yamamoto's ERATO group includes researchers at Stanford and at two corporate laboratories in Japan. We included Professor Yamamoto in a number of the Center's activities and laid the framework for formal interviews concerning his project and the ERATO program in general. During the 1995-1996 grant year, the Center's director Dasher interviewed Professor Yamamoto. This interview, which was published in the Winter 1995-96 edition of the Center's *Update*

newsletter, reported on the organization and procedures of the ERATO program, as well as on the goals and activities of Professor Yamamoto's project. We made plans to obtain and distribute further information on ERATO projects in subsequent grant years. As mentioned under Section 2.1, Professor Yamamoto participated in the Spring seminar series on Nanotechnologies and served as advisor in planning the series.

We broadened our focus, however, in order to keep pace with recent major developments in the Japanese system for supporting advanced technology research. Such major developments included the following:

- Legislation, formal planning, and major investments by the Japanese government to improve its infrastructure for basic and "strategic" research.³
- Japanese government efforts to improve cross-sector cooperation among universities, industry laboratories, and Japanese national laboratories.
- New procedures in Japanese government grant programs that aim at increasing effectiveness and efficiency.
- Efforts by national, regional, and local governments and industry associations to develop a Silicon Valley-type entrepreneurial environment in Japan.
- Apparent efforts to increase international involvement in Japanese research projects
- Other efforts by corporate, university, and government R&D programs to increase creativity in Japanese laboratory settings.

In consideration of such developments, which are further described below, we focused our technology management research in this area on the structures, organizational dynamics, and missions of Japanese R&D consortia and Japanese government funding programs in the context of the changing roles and cross-sector interactions between Japanese industry, its academic community, and its government.

³ "Strategic research" is a term used by some Japanese S&T policy experts in reference to research that forms a link between basic and applied research areas. This term probably reflects an approach often seen in Japanese government support for R&D, namely the identification and emphasis of certain key technology areas that are predicted to enable the development of a wide range of products in the future.

As before, we concentrated on programs that support advanced technology research in our technical fields of emphasis.

Events in Japan during 1995-96 represented the initial stages of major changes in the system of Japanese support for science and technology research. While Japan has long excelled in applied research, development, and commercialization, the Basic Science and Technology Law (1995) and its mandated Basic Science and Technology Plan (a five-year plan for 1996-2000) legislate increased Japanese government responsibility to support the development of a stronger infrastructure for basic and "strategic" research.

Significant Japanese government funding increases at this time were matched by new policies and by experiments with new patterns of support. For example, during this year, the Agency for Industrial Science and Technology (AIST), a MITI-affiliated agency, for the first time initiated a system of outside peer review in the proposal review process for certain of its grant programs. Some new large-scale programs, e.g. MITI's \$300 million program in support of electronic commerce-related R&D, have abandoned the traditional approach of a central research facility plus distributed efforts in major corporation laboratories in favor of more open competition for smaller grants (typically between \$1 million and \$2 million each). Some of these new programs require Japanese investigators to engage a foreign partner for their research. This innovative feature has the stated goal of introducing greater creativity and entrepreneurial spirit into the Japanese research community. Through such new policies and initiatives, the Japanese government is seeking to break down many of the walls to cross-sector collaboration between universities, industries, and government laboratories. For example, national university professors are now eligible to perform limited private consulting.

Such regulatory reforms have continued from 1998 to the present, with even greater emphasis on encouraging the development of Silicon Valley-style start-up companies and closer university-industry relations. Some major examples include:

- The 1998 legislative authorization of technology licensing organizations (TLOs) to administer and market intellectual property rights on behalf of university and national lab researchers. Unlike American university technology licensing offices, however, Japanese TLOs are independent nonprofit entities (licensed under MITI, now

the Ministry of Economy Trade and Industry--METI) that have no automatic claim to the intellectual properties originating from the research organizations that they serve.

- Faculty policy changes, including rules to allow part-time consulting (from 1996), participation on corporate boards, and even moonlighting as an officer of a corporation (from 2000).
- The creation and promotion of regional cooperative (university-industry) research centers, typically located in university facilities. Such facilities provided mechanisms to enable companies to conduct joint research with a university without going through the yearly appropriations processes of the Ministry of Education and the Ministry of Finance.
- The creation (under the Ministry of Education) of "venture business laboratories" to incubate companies in university-based facilities. At present there are more than 60 such incubators at national and major private universities in Japan.
- The privatization of national universities and national laboratories into "independent administrative entities" (*dokuritsu gyousei houjin*), a process that is still ongoing.

As noted above, many of these regulatory changes are either still in process, or they are so recent that their effects are not yet well-known. Similarly, the January 2001 reorganization of the various ministries of the Japanese Cabinet is likely to have major effects on the framework for supporting and administering science and technology projects in Japan. For example, the Science and Technology Agency (STA) was folded into the Ministry of Education, and all of the separate national laboratories under the Agency of Industrial Science and Technology (AIST) have been merged into one new organization, called the New Advanced Institute of Science and Technology (New AIST), which will become a privatized *dokuritsu gyousei houjin*. Consequently, such changes bear continued observation and analysis.

One point that is clear, however, is that from about 1998, Japan came to look especially to Silicon Valley for new models that would enable it to achieve goals of policy developments and public investments such as those outlined above. Silicon Valley was seen as the center of many recent U.S. successes, especially the explosive growth of computer networking and software industries. In this view, Silicon Valley

presented a model of successful, creative entrepreneurship, in which small, venture capital firms built around emerging technologies have the power to develop major new industries. Silicon Valley was also seen as a model of venture capital investment. Due to the low rate of return in traditional investment channels in Japan, many Japanese institutions (ranging from finance companies and trading companies to private universities and large manufacturing companies) are aggressively exploring venture capital investments as an avenue for more lucrative returns. Some companies and professional private investment houses (e.g. JAFECO) began investing directly in Silicon Valley; many more began to try to learn about Silicon Valley models of spinning off new companies and other mechanisms of transferring technology from university and national laboratories to the commercial sector. Finally, Silicon Valley came also to be seen as a critical model for new technology areas that may enable regional economic development to overcome the intense centralization of industries in Japan in a few urban centers. Electronic commerce is still seen by many local and regional development organizations in Japan as a business sector in which traditional geographic limitations on market growth do not apply.

The USJTMC capitalized on our vantage point as an organization in Silicon Valley in order to monitor and study the Japanese as they studied and tried to import the Silicon Valley models of innovation. Our position gave us many excellent windows into the changing situation in Japanese support for R&D. Sources of information included a large number of visitors from Japan, guest speakers from Japan in our seminars and other public programs, and selected visits to Japanese organizations by USJTMC staff, often with other Stanford faculty. In addition, Stanford faculty in various fields have assisted us in gathering information directly from their network of high-level Japanese contacts. During the grant years, we integrated our discoveries in this area into the content of our educational and outreach programs for the science, engineering, and technology management communities both inside the University and in U.S. industry and government. Examples can be seen in the recent EE-402a seminar series (Section 2.1 above). In addition, we shared our ongoing results with technology management experts through conference presentations and other communications (see Section 4.0 "Outreach").

Another valuable source of information during the grant years were visitors from Japan, who provided many documents, supporting material, and information on changes in Japanese support for science and technology. Japanese visitors to the

USJTMC have included members of the Japanese National Diet (parliament); the Acting Commissioner of the Japan Patent Office; high ranking officials from MITI, AIST, NEDO (the New Energy and Industrial Technology Development Organization), STA (Science and Technology Agency); and executives from a number of major Japanese corporations. Among other data, these visitors supplied the Center with a pre-publication draft of the Basic Science and Technology Plan, outlines of numerous new Japanese funding programs, and other planning documents.

The seminar series also played a valuable role in our information gathering; through them we brought in many speakers from Japan who reported on changes in Japanese funding programs. Such speakers included Dr. Junichi Shimada, Director of the Real World Computing Program, who explained the reorganization and refocusing of research in the RWCP that resulted from its recently completed mid-term review, and he put it into the context of other MITI funding programs for optoelectronics. Similarly, Mr. Koji Matsukura, executive director of the Japanese industry association for optoelectronics, the Optoelectronic Industry and Technology Development Association (OITDA), spoke about Japanese industry and government funding programs and research interests in this area. Mr. H. Setoya, executive director of the Association for Super-advanced Electronics Technologies (ASET), and Dr. Maruyama, director of the Atom Technology Project (ATP) likewise shared with our audiences, and informally with USJTMC researchers, their perspectives into changes in their own programs and the larger system for Japanese government support for R&D.

Such seminar presentations exemplify our approach of integrating this ongoing research with our education and outreach activities in a real-time way. We have thereby provided critical information to target audiences in the U.S. that have an immediate need to understand the changing situation in Japan, e.g. American high technology companies and industry associations. Beginning in 1998, the USJTMC has also been placing all such materials into a public online archive for reference and subsequent analysis. During the grant years, we received a number of requests from U.S. companies and government agencies for copies of the videotapes of our seminars, which we have provided at cost.

The USJTMC also delivered the results of insights by Stanford specialists and other JIITMT centers into Japan's changing support for science and technology research by organizing a special panel session at the general meeting of the International

Association for Management of Technology (IAMOT) in Miami, Florida, in February 1996. As is discussed under Section 5.0 "Cooperation with Other Centers," the USJTMC organized a panel session of four JITMT directors at this conference. The changing situation of Japanese support for S&T research was one of the major topics of discussion during that session.

Another channel for obtaining information about the structure and dynamics of Japanese research consortia were visits by USJTMC personnel to selected Japanese industry associations and laboratories, including:

- Advanced Telecommunications Research (ATR) labs, now under the Japan Science and Technology Corporation
- Intelligent Manufacturing Systems Promotion Foundation (Tokyo)
- Micromachine Center (MMC) (Tokyo)
- Optoelectronics Industry Technology and Development Association (OITDA) (Tokyo)
- Tsukuba Research Consortium

In addition to providing us with valuable insights into the range of different types of management structure and into the relationships between these nonprofit organizations and Japanese government funding programs, these visits also provided us with up-to-date information on the technical areas of research at these organizations. In turn, this information was used to plan and deliver public programs, such as our seminar series.

3.1.2 Flat Panel Display Manufacturing

At the outset of the current grant, USJTMC faculty and Ph.D. student researchers were completing their study of cost factors in flat panel display (FPD) manufacturing under the no-cost extension of our previous JITMT grant. Consequently, under our new grant, the USJTMC placed the focus of this research area into information collection via the Spring 1995 seminar series "Flat Panel Displays: Views from the U.S. and Japan" (see Section 2.1).

This seminar series delivered up-to-date information on the FPD industry, its emerging trends, and the technical and management issues that affect the direction of its development. In addition, they provided USJTMC researchers as well as our audiences from U.S. industry and government organizations with direct contacts to key industry

players and information on the newest developments in the industry. Substantive issues addressed by the expert speakers in this seminar series included:

- Current and future FPD applications and markets
- FPD manufacturing process difficulties and solutions
- Possible leapfrog technologies to over current TFT-LCDs
- Niche market applications of emerging display technologies

The series also included demonstrations of new devices, such as a prototype 21-inch TFT LCD by Sharp Corporation and an EL display by Planar Systems.

This seminar series thus integrated our information collection for research in this technical area with our ongoing education and outreach. In addition, at the end of the grant year, the USJTMC published a volume of bound proceedings of this series. As mentioned in Section 2.1, the proceedings are attached to this report as Appendix C.

3.1.3 Other Study of Advanced Technology Management

During 1994-95, the USJTMC engaged Stanford Professor Robert White (Department of Materials Science and Department of Electrical Engineering) to write an article on changing technology management practices at Sony Corporation. Professor White provided us with his effort for goodwill, and we distributed his article in the Winter 1995 issue of our *Update* newsletter.

Prof. White had just spent three months at Sony's Central Research Laboratory (Yokohama) in a Sony-sponsored sabbatical program. During that time, Sony leaders were conducting a major reorganization and self-examination of their company's technology management practices. Professor White's position as a visiting distinguished scholar under Sony corporate sponsorship provided him with excellent access to many levels of corporate decision-making structure. Consequently, he had a rare vantage point from which to observe a major Japanese company's reexamination of its traditional system of job rotations and consensus-based decision-making in the context of a need for critical decisions about its strategic direction.

3.2 Ongoing Trends Analysis of Selected Technology Areas

The USJTMC's efforts in analyzing Japanese research trends originated during our previous JITMT grant, through which Prof. Joseph Goodman provided a technology

assessment of optical logic and optical interconnects research in Japan. Under our current grant, we used 1994-95 to collect information and prepare for new research efforts in this area. For example, the seminar series on FPD technologies and industry included a first-hand report by Dr. Mark Hartney of DARPA/ESTO on the SEMICON / Flat Panel Display Forum in Yokohama, Japan, which had just recently taken place (in April 1995). Similarly, through our discussions with the delegation from the U.S.-Japan Joint Optoelectronics Project in June 1995, we obtained updated information on Japanese research in that technical area. As is discussed in Section 3.3, we used our machine translation and Internet information dissemination projects in order to collect information on Japanese research in optoelectronics and micromachines. During the subsequent grant years, the USJTMC expanded and updated Professor Goodman's earlier study. This second trends analysis has likewise been placed in a public archive on our Internet website. We sponsored a presentation by Prof. Goodman in our seminar series on optoelectronics, in which he delivered an on-site report via live, two-way videoconference from the Optical Computing '96 and Photonics Transport '96 conferences in Sendai, Japan. Professor Goodman provided our audience of over 100 industry visitors, Stanford students, and Stanford faculty with a critical review of new Japanese research results in optical computing less than twenty-four hours after their announcement at these conferences.

Also in spring 1996, Acting Professor Richard A. Kiehl joined the Stanford faculty of Electrical Engineering from the Exploratory Devices division of Fujitsu Research Labs (Atsugi, Japan). In addition to his technical research, Professor Kiehl has published papers on the structure of Japanese funding mechanisms for nanoelectronics research, and delivered presentations on creativity problems in Japanese laboratory environments. On joining the faculty officially affiliated with the USJTMC, Prof. Kiehl spearheaded the development of a prototype website for trends analysis of Japanese research in nanoelectronics, which at the time was the subject of several separate major funding programs in MITI, the Science and Technology Agency, and the Ministry of Education. This website directory became part of our *J Guide* to Japan online information resources, the official World Wide Web Virtual Library site for "Japan." We continued to update this website after Prof. Kiehl's departure for a tenured professorship at the University of Minnesota.

After the conclusion of the referenced grant, the USJTMC has continued its efforts in trends analysis research with other sources of support. Among our projects in

this area, we include support from the Fujitsu Research Institute to study the integration of data mining algorithms in decision analysis applications, support from METI/JETRO to study the impact of system-on-chip technologies on the structure and dynamics of the world semiconductor industry, and support from a Toyota-affiliate company to study the impact of the Internet on business models along the automobile industry supply chain.

3.3 Development of Electronic Information Technologies for Distribution of Japan Information

USJTMC activities under the referenced grant in this research area centered on Internet website development and machine translation. Chief among our Internet projects during the year were the *Japan Window*, our prototype website for the National Diet of Japan House of Councillors, our Web-based distribution of information from the Micromachine Center, and our continued development of the *J Guide* directory of on-line Japan information resources.

3.3.1 *Japan Window*

Japan Window was a collaborative project between the USJTMC and Nippon Telegraph and Telephone (NTT) Software Laboratories to develop a new-generation Internet site on the World Wide Web dedicated to providing Japan information. JITMT grant funds allocated to this project were used only in support of the USJTMC student and staff effort. NTT directly supported all of its costs of participating in the project, including the salaries and benefits of its team members and its infrastructure costs. In addition, NTT provided the project with valuable technical expertise, information content, and contacts to major information providers. The *Japan Window* further received in-kind contributions of technical support from WAIS, Inc., an Internet search engine development firm. *Japan Window* was designated an official project of the nonprofit organization Smart Valley, Inc. Smart Valley volunteers such as Mr. Regis McKenna (Chairman, The McKenna Group) provided Stanford project members with highly valuable project management mentorship.

Discussions between Stanford and NTT in regard to creating *Japan Window* began during mid-1994. Our work on this project began in the autumn of that year. Stanford personnel who regularly participated in this project during the year included graduate student research assistant Burton Lee (Department of Mechanical Engineering), who served as project manager for the U.S. side, graduate student research assistant Junhe

Liu (Department of Computer Science), undergraduate students on hourly pay, and Ayako Yamazaki (USJTMC staff webmaster). NTT provided many joint resources for this project at no cost to Stanford. In addition to providing their facilities for weekly *Japan Window* team meetings, NTT hired additional Stanford students as temporary hourly employees for the project. The NTT team delivered important website content, and they shared significant technical expertise in developing new software technologies with our Stanford participants.

Japan Window was first opened to the public in March 1995. It contained the following categories of Japan information:

- Government
- Science and Technology
- Business and Finance
- Living and Travel
- Kids' Window
- Daily News and Updates

USJTMC team members focused on developing the "Government" directory first. This area provided an excellent forum for developing a consistent approach to the standardization of information content and format for the site, as well as for exploring solutions to cross-cultural differences between U.S. users' expectations and Japanese traditions of information distribution. The USJTMC's team members also began work on the "Science and Technology" and "Business and Finance" directories. NTT took the primary role in developing "Kids' Window," "Living and Travel," and "Daily News and Updates."

Research aspects of *Japan Window* included the development of software and procedures for distributed website management and an interactive public event calendar, in which users themselves would input information about upcoming events. Research aspects of *Japan Window* center on joint website management and software development by a U.S.-Japan team in different physical locations, and on empirical study of the market for Japan information. During the grant year, the team made excellent progress in overcoming technical challenges related to distributed website management and website automation. *Japan Window* was distributed to the public via two server workstations, one at Stanford and one at NTT. Consequently, their mirroring

involved crossing firewalls and other complex networking issues. New content was developed independently on each server and mirrored to the other server automatically in a batch each night. NTT and Stanford team members developed and refined "cockpit" software to establish consistent protocols and avoid accidental deletion of new content during the automatic mirroring. During the grant year, Stanford graduate student research assistants also gained experience developing and implementing "spider" routines for automatic checking of the hypertext links to other websites.

Meanwhile, NTT personnel took the lead in developing software for new interactive features for *Japan Window*. Their contributions included implementing a "chat" page for real-time text and graphics message exchanges by multiple users and also the "Democratic Wall" for message posting on a variety of U.S.-Japan topics. *Japan Window* was thereby one of the earlier adopters of "chat" technology on the Internet. As noted in the Outreach section of this report, these interactive features appear to have played a role in the significant increase in accesses to the *Japan Window*. Thanks to the efforts by NTT, Stanford team members learned a great deal about interactive software; both teams of the project also gained considerable hands-on experience in website management, including close monitoring of interactive pages to avoid inappropriate messages and other potential problems. The team also continued their close monitoring of statistical data on user accesses to the various directories of *Japan Window*.

Stanford participants presented papers on the *Japan Window* project at major international meetings during the grant year. These included the general meeting of the Internet Society and other major conferences (see publications list in the Appendix). The project received much favorable attention in the press, including mentions on Japanese NHK television. The project, notably the *Kids' Window* directory, received a number of awards for excellence from third parties.

During the grant year, interactive, multi-user calendar management software developed by Stanford members of the *Japan Window* team was licensed gratis to the nonprofit organization Smart Valley, Inc. (Santa Clara, California). Smart Valley had recognized *Japan Window* as one of their official community development activities since the inception of our project. Through their sponsorship, Smart Valley provided *Japan Window* with many contacts to users and providers of Japan information. They also arranged for the donation of valuable consulting services to Stanford members of the project by Mr. Regis McKenna (chairman, the McKenna Group), who is well-known for

developing successful initial market entry and management strategies for over sixty start-up companies in Silicon Valley, including Apple Computer, Sun Microsystems, and Genentech.

Japan Window received an excellent response from the Internet community from the time of its opening. In addition, it attracted considerable attention in the press. During the following grant year, *Japan Window* continued to receive heavy use from U.S. persons and organizations with an interest in information on Japan science and technology and other areas. This aspect of the project is reported on in Section 4 "Outreach."

The lifespan of *Japan Window* as a research project was ended by the rapid spread of the Internet World Wide Web and the concomitant development of commercial solutions to many of the challenges of website management. Stanford University decided in 1996 that the project no longer belonged in the framework of university research or education, and so it transferred the right to operate *Japan Window* to NTT. In contrast, our efforts in regard to the *J Guide* directory of Japan information resources (see below) were deemed to provide useful education and training for Stanford students, because it put them into direct contact with Japanese sources of information and posed to the students challenges in organizing and classifying that information. Consequently, we continue to operate *J Guide* within the framework of the University.

3.3.2 Prototype Website of the National Diet of Japan House of Councillors

The USJTMCM hosted Mr. Shuichi Ohtsu, a member of the public affairs staff of the National Diet of Japan, House of Councillors, as a visiting researcher from September 1994 through February 1995. Mr. Ohtsu has published a number of articles and a book for the Japanese computer industry press on the development of the Internet and on "C" language. Mr. Ohtsu's salary and expenses were paid through a staff development program of the Japanese National Personnel Authority. The USJTMCM devoted some student and staff resources to cooperate with Mr. Ohtsu in developing a prototype website to introduce the National Diet of Japan.

This cooperative effort led to a website that received approval from the Diet for public release. Thus, from 1995 until the Diet's release of its own websites, the USJTMCM provided the world with the only official on-line description of the Japanese National Diet, Japan's legislative process, and key policy statements by Japanese parliamentarians

in regard to S&T issues. Following the official release of the Diet's own website, we replaced our prototype site with a link to an official Diet homepage but kept our site publicly viewable as an archive. This project led to close communications and contacts for the USJTMC with various Japanese government organizations, and it provided us with a reputation for positive cooperation that opened many doors for our other projects.

3.3.3 Dissemination of Micromachine Center Information

Also during 1994-95, the USJTMC secured permission from the Micromachine Center (MMC), a MITI-affiliated industry association in Tokyo, to develop and make public a provisional Internet website to deliver information on MMC activities and research, including an online archive of their working papers and research publications. Like many Japanese industry associations, the MMC plays an important role in administering Japanese government-funded grant programs and other research contracted out by the Japanese government. It also serves as an important discussion forum in which Japanese companies share with each other and the Japanese government their visions of the direction and emerging needs of the industry. Our provisional site was public from from September 1995 until the release of the official MMC website one year later. Our efforts also established us as an information point for U.S. organization with an interest in Japanese activities in this technology area, and we believe that we have had a small role in opening up Japanese attitudes toward information sharing on the Web.

3.3.4 The Stanford "*J Guide*" to Online Japan Information Resources

The *J Guide* was originally developed and released to the public under our previous JITMT grant with the name "*X-Guide*" for "Experimental Guide" to Japan Information. It focused on improving access to Japan information through a topically arranged directory of Japanese information sources. *X-Guide* provided an early, user-friendly listing of links to hundreds of Japanese government, corporate, and other websites. Its focus thus differed from that of *Japan Window*, which placed greater emphasis on proprietary information about Japan that was developed largely in-house by the *Japan Window* team.

During the grant term, we conducted several expansions and reorganizations of the *X-Guide*. During this time, the number of websites in Japan proliferated rapidly, but there was little consistency in the patterns of organizing information. In general, the

large (and increasing) number of unintegrated websites in Japan made it a difficult task to locate the appropriate sources for a desired item of information. Several graduate students and staff time were devoted to this project. In light of the explosion of Internet-based information from Japan, *X-Guide* came to serve as an even more important resource for easy access to Japan information. For example, the *X-Guide* provided one of the most comprehensive directories of Japanese government websites that was publicly available in 1995-96.

We conducted a major systematic review of the topics and arrangement of the *X-Guide* directory in late 1997. Our method involved comparison with various library classification systems as well as other topically arranged Internet directories. Recognizing that we had reached a new stage in this project, we renamed the site to be the Stanford "*J Guide*" Directory of Online Japan Information. Up until this time, the USJTMC was separately administering the *WWW Virtual Library* entry for Japan. The *WWW-VL* provided a similar service to that of the *X-Guide*, and so there was considerable synergy in conducting both activities, but at the time the *WWW-VL* format was standardized and somewhat incompatible with the Japan-focused arrangement of information in *X-Guide*. Following our review, reorganization, and expansion of the new *J Guide* in 1998, we received permission from the *WWW VL* administrators to combine these projects under the *J Guide* website, so that *J Guide* is now the official entry for Japan in the *WWW VL*.

As with *Japan Window* (above), we have focused this section only on the development aspects of *J Guide*. Statistics on access to these websites and related information appear in the present report under Section 4 "Outreach." Our USJTMC websites have received many awards for quality, including the highest rating (four stars) from Magellan for its content and design. The *J Guide* received special mention as one of the best Science and Technology sites by *Computing Japan*. In contrast to *Japan Window*, we have continued to operate *J Guide* following the conclusion of the referenced grant. This activity keeps us in close touch with many sources of Japan information, and it provides students with valuable lessons in how information is organized and categorized in Japan. The *J Guide* was one of ten sites selected to demonstrate the Internet in education in a special exhibition at the Disney Epcot Center in January 1998.

3.3.5 "Converter Plus"

As mentioned in Section 2.4, USJTMTC student research assistant Albert So and staff member Ayako Yamazaki wrote a Java applet for automatic conversion of distance, weight, area, and other measurements between the U.S. and metric systems. This *Converter-Plus* feature further provided a new study resource for technical Japanese language. It presented the names of measurement units both in Japanese and in English. Each term is presented with a corresponding sound file to introduce the correct pronunciation. This feature also contained automated stroke-by-stroke presentations of the Chinese characters used to write each Japanese technical term. After extensive in-house testing, *Converter-Plus* was made public on our homepage in June 1996. It has been featured in the *Los Angeles Times* and the America On-Line homepage.

3.3.6 Machine Translation System Benchmarking and Applications Development

Through 1997 the USJTMTC continued to receive (gratis) new upgrades of Fujitsu's ATLAS machine translation (MT) system via a separate research agreement with Fujitsu. We utilized this system to support our ongoing efforts, sponsored by our JITMT grant, in monitoring Japanese research in select technical areas. By means of the ATLAS MT system, we provided draft-quality English language translations of Japanese language technical articles, trade newspaper articles, and news releases to Stanford faculty and other key U.S. researchers in electrical engineering, computer science, applied physics, mechanical engineering, and other technical fields. In many instances the information provided was unavailable in any other English-language source at the time.

As part of our JITMT research, we also continued to develop new applications for the MT system, using it to build vocabulary lists and exercises for our JITMT-sponsored university course "Reading Technical Japanese." Results were reported on at workshops on teaching technical Japanese that were sponsored by the University of Washington JITMT center in September 1994 and September 1996, and at the JICST Conference on Accessing and Using Japanese S&T Information, Boston, 1995. Our MT research also included the development of a user dictionary of technical terms not found in the MT dictionaries supplied by Fujitsu. Our efforts thus provided us with up-to-date information on newly emerging Japanese technical terms.

Early in the grant term, we still found relatively little substantive S&T information in the Internet websites of Japanese information providers. Instead, most

Japanese websites contained only limited publicity materials, such as mission statements and organization charts. Therefore, at that time most of the texts for input into our machine translation system were hard copy of published papers, technical reports, news articles, etc. By the end of our benchmarking efforts (in early 1998), online information was much more readily available. Major corporate-internal publications ("gray literature") such as *The Toshiba Review* and *The Hitachi Review* had begun to place abstracts, and in some instances full-text articles online. Nevertheless, probably as a result of limited resources for translation into English, there was consistently much more information available in Japanese than in English on corporate sites, government research facility websites, and academic websites. This development showed promise for increasing the value of MT systems, but their limitations in quality (see below) still made them more useful as pre-editing tools for bilingual specialists than as stand-alone tools for engineers and scientists.

For consistency in the benchmarking of the ATLAS system, we did not do any post-editing of output documents. We limited our pre-editing of input documents to corrections of typographical errors. Nevertheless, the preparation of hard copy documents for input into the system by means of scanning and OCR proved to be a long, tedious process that limited the amount of text we could deliver. A ten-page technical paper took about seventeen hours of preparation time before being processed through the MT system itself. A major problem continued to be the need to hand-correct the misreadings of Japanese characters generated by the OCR. It should further be noted that all of the user interface for this MT system is in Japanese, and so a sophisticated knowledge of that language and its lexical and grammatical structure is essential in order to achieve the best possible results from the MT system. In contrast, Japanese information obtained from electronic sources (i.e. Japanese-language text files) required relatively little pre-processing for the MT system. Therefore, as more substantive Japanese S&T information appears on the Internet, machine translation may become a more useful and cost-effective tool.

Newer versions of ATLAS required less computer memory and achieved shorter processing times. Nevertheless, the quality of the unedited English output prose throughout the project continued to be very rough in comparison to that of any human writer. Moreover, Japanese is known as a "high-context" language, in which words such as the sentence subject can be omitted if understood from the context. No MT system had yet been developed that can bring into play the contextual and encyclopedic

knowledge that Japanese native speakers use in reading their language. At best, the MT system merely marks such a sentence as having an undetermined subject. Consequently, native English readers judged some output sentences to be hopelessly ambiguous.

Stanford faculty, however, were generally pleased to receive information about research results and technical announcements in Japan before that information became available in official English translations. The MT output in most instances provided a gist of the original text. Only in a very few instances did the rough quality of the output English lead to an incorrect (mis)understanding of the intended meaning. We also continued to notice gradual improvements in faculty scoring of the MT output as our readers became more familiar with the characteristics of that prose.

4.0 Outreach

As mandated by the JITMT program, the USJTMC placed great effort into outreach beyond the university community, so as to deliver the benefits of our programs to engineers, scientists, and technology managers in U.S. industry and national laboratories. Our primary channels include our public programs, publications and presentations, and our Internet websites.

4.1 Public Programs

Our public programs included the opening of many of our educational offerings to the public and also separate programs. As noted in Section 2, our seminar series on Japanese technology management were broadcast over the Stanford Instructional Television Network to their member companies. We estimate that over 75 companies in the Silicon Valley area enrolled their employees as students through SITN. These included major defense contractors, e.g. Hughes Aircraft, Lockheed Martin, Silicon Graphics, Oracle Corporation, Cisco Systems, and other high tech firms with an interest in Japan.

A much broader range of companies sent participants on a casual (non-registered) basis to our seminar series. Attendance was as high as 250 persons at some sessions, and this number included even more visitors than Stanford students and faculty. Visitors came from defense contractors; other major semiconductor, electronics and computing companies; small technology-based companies; U.S. industry associations and consortia; and other research-related and consulting firms. Our online publicity led to visitors from as far away as Minnesota (3M) and New Jersey (Bellcore).

All in all, we estimate that our seminar series during the grant term reached approximately 4,000 unique individuals in over 500 companies. Although Stanford's geographic location is distant from most major military laboratories, we also had frequent visitors in our seminars from Lawrence Livermore, Sandia, Lawrence Berkeley, and NASA Ames national labs.

Separate from our course offerings, the USJTMC presented a number of public programs. At the outset of the grant term, we presented a major one-day public conference on "The Future of Japan's National Information Infrastructure" on October 1, 1994. Distinguished speakers included Prof. Jun Murai (Keio University), Dr. Shigeki Goto (then Executive Vice President, NTT Software Labs), Dr. Teiichi Aruga (Managing Director, Nomura Research Institute), Mr. Izumi Aizu (Research Director, Center for Global Communications—Glocom), Dr. Seiichi Takeuchi (Corporate Senior General Manager, Sumitomo Electronics), Mr. John Stern (Vice President for Asia, American Electronics Association), Mr. Tak Matsumoto (General Manager, Cisco Systems Japan), Mr. Joichi Ito (founder, Bekkoame and subsequently angel entrepreneur), Ms. Yasuyo Kikuta (General Manager, Information/Database Development Project, Fujitsu Limited), and others. This event was the first-ever conference in the U.S. that examined the future of the Internet in Japan. It attracted over 350 persons to the Palo Alto venue, including several representatives from AFOSR. A copy of the proceedings is included in the Appendix of this report.

Many of our public programs were live, two-way TV conferences in cooperation with Japanese partners. Our first TV conferences began through an arrangement with TEPIA, a large exhibition facility and business information center in central Tokyo that is administered by the TEPIA Foundation, itself a nonprofit organization under the auspices of MITI (now METI). Beginning in summer 1994, in cooperation with TEPIA, the USJTMC pioneered real-time public programs via TV conference with audiences both in Tokyo and at Stanford; on occasion we included third sites as well, such as Paris, France; Seattle, Washington; and elsewhere in Japan. These programs were carried out in English and in Japanese via simultaneous interpretation. The videoconference link was via cost-effective digital compression technology, in which the signal was carried over two long distance ISDN telephone lines at 64 kbps each: one for video and one for audio. Our cooperative efforts with TEPIA were among the first-ever public programs that made use of this technology, which—while lower in quality than a satellite link—was less than 1/20 as expensive (at the time). We further experimented with

Internet-based streaming video conferencing, but during the term of the grant these technologies did not support resolutions high enough to be displayed by projectors in large auditoriums.

In conjunction with TEPIA, we presented TV conferenced programs on the following topics:

- International Symposium on "Intelligent Measurement" (7/06/94)
- International Symposium on "The Digital Age" (4/26/95)
- Student "Robot Competitions" (yearly from 1995 – 1997, inclusive)
- International Seminar on "Multimedia Technologies and Disaster Management" (9/20/95)
- International Seminar on "Security Issues in Cyberspace" (10/25/95)
- International Seminar on "New Human-Computer Interfaces" (11/15/95)
- International Symposium on "Wings to the Future: The Present and Future of Aircraft Technologies" (10/15/96)
- International Seminar on "Air Traffic Control Technologies" (10/30/96)
- International Symposium on "The Present and Future of Electric Power Supply Systems" (9/10/97)
- International Symposium on "Developing the Future through Manufacturing" (10/08/97)

More details about the above TV conferenced events appear below. Funds from the JITMT grant were used only to cover Stanford-side expenses of publicizing the program to the Silicon Valley area, securing the facilities on this side, and staff effort for coordinating the events. TEPIA paid the costs of the communications link, program coordination and publicity in Japan, and simultaneous interpretation.

International Symposium "The Digital Age" (4/26/95)

The 4/26/95 program included a virtual tour (by roving TV camera) of TEPIA's exhibition of new Japanese products and technologies, such as a gesture-based human-computer interface system by Fujitsu Ltd., a skiing simulation system by NTT, and other exhibits by NHK Enterprises, NEC, and Ohbayashi Corporation. It also included one hour of U.S.-Japan discussion, in which the Stanford audience discussed topics such as

technical standards for image compression technologies and other trends in multimedia technologies and business with the Japanese presenters and audience. This symposium attracted an audience of 68 persons at Stanford and about 250 persons in attendance in Tokyo. In addition to faculty and senior School of Engineering administrators, Stanford attendees included representatives from Lawrence Livermore National Laboratory; industry organizations such as the Bay Area Multimedia Technology Alliance, Smart Valley Inc., CommerceNet, Hewlett-Packard, Oracle, Silicon Graphics, SRI International, SUN Microsystems, TRW, and others. The audience in Tokyo included not only Japanese company and government representatives but also members of the American Chamber of Commerce Japan. The event also attracted a number of members of the press.

As an experiment, the USJTMC also relayed the 4/26/95 videoconference with TEPIA over the Internet via the beta version of CU-SeeMe videoconferencing software. Participants at Ohio State University, the Exploratorium Museum in San Francisco, and elsewhere in the U.S., Europe, and Singapore logged into the videoconference through this channel. Nevertheless, inferior picture quality of the CU-SeeMe image and the inability to involve Internet participants in the actual videoconference discussion led us to conclude that this technology was not suitable for such a program.

Student Robot Competitions (yearly in 1995, 1996, 1997)

In cooperation with the Japan Society of Mechanical Engineering and the Tokyo Institute of Technology, the USJTMC and TEPIA co-presented student robot competitions for three years from 1995 - 1997. Prof. Shigeo Hirose (Mechanical Engineering, TITech) and USJTMC Director Dasher provided overall coordination for these events. Student teams were from Japanese universities; they had designed and built robots designed to perform various tasks that, in addition to being entertaining for the audiences at the competition, addressed issues of considerable difficulty for robot mechanical structure and above all, control. Stanford supplied judges to a judging panel that was distributed both at TEPIA and at Stanford. Judging responsibilities were shared by Prof. Bernard Roth and Prof. Mark Cutkosky (both Mechanical Engineering) at Stanford. The USJTMC and TEPIA publicized these events both in Japan and in the Silicon Valley, attracting audiences of about 45 persons at Stanford and over 150 at TEPIA. Attendees at Stanford included employees of Applied Materials, Hewlett-Packard, SUNSoft, SRI International, and other companies.

Three Topical Seminars , autumn 1995

As listed above, the USJTMC and TEPIA co-presented international seminars on "Multimedia Technologies and Disaster Management ," "Security Issues in Cyberspace," and "New Human-Computer Interfaces" in autumn 1995. The first of these seminars reflected the intense concern both in Japan and in California during the year following the major earthquakes that had occurred in Northridge, California, and Kobe, Japan. From TEPIA, Professor Osamu Koide (University of Tokyo) and Dr. Shujiro Tsuchida (NEC) gave presentations on computer simulation technologies for evacuation scenarios and multimedia devices used following the Kobe Earthquake, respectively. From Stanford, Mr. Scott Grago, Emergency Preparedness Manager (Pacific Bell) presented an expert comparison of disaster management in the Northridge, California, and Kobe earthquakes. This seminar attracted 26 attendees at Stanford and about 75 in Tokyo. Although not a large audience at Stanford (due to a university vacation at the time), Stanford attendees included representatives from the Federal Emergency Management Agency (FEMA), the San Jose city Emergency Preparedness Coordinator, and also staff scientists from Lockheed-Martin, NASA Ames, SRI International, Fuji-Xerox Palo Alto Laboratory, and the University of California San Francisco medical center.

The "Security Issues in Cyberspace" TV conference on 10/25/95 covered the emerging issues of technology vulnerability and methods for sharing information to protect large networks from attack. From TEPIA, we received a presentation on the Japanese hacker community by a Japanese journalist who had gone underground into that society. From Stanford, Mr. Brian Rudin, then VP of Visa International, presented the results of U.S. government-industry discussions into a system and protocols for secure electronic commerce transactions. This seminar was attended by about 75 people at Stanford and over 200 people at TEPIA.

We attracted a similarly large audience for the "New Human-Computer Interfaces" seminar on 11/15/95. Japanese-side presentations focused on cross-cultural and commercial applications of new human-computer interfaces, and Stanford provided a presentation of the results of the "Archimedes" project of the Stanford Center for the Study of Language and Information, which had developed an interface for severely handicapped persons.

Two TV conferences on aircraft and related technologies, autumn 1996

Our autumn 1996 TV conference programs focused on Aircraft Technologies, including an October 15th virtual tour of TEPIA's exhibition "Wings to the Future: The Present and Future of Aircraft Industry Technologies." The program included presentations by Dr. Kaumi Hirano of MITI/AIST Mechanical Engineering Laboratory on a major new Japanese government funding program in "Smart Structural Systems." This was the first U.S. announcement of this program, which was still in the process of formulation at the time of the TV conference. The 10/30 TV conference examined Aircraft Control and Air Traffic Control Technologies, including a presentation about a GPS-based precision aircraft landing system by Dr. Clark Cohen, President, IntegriNautics. From Japan, Dr. Minoru Higashigushi, Professor of Mechanical and Controls Engineering, Tokyo Institute of Technology, made a presentation on studies to improve aircraft fuel efficiency via formation flights, in which aircraft maintain positions in the vortex of lower pressure air that follow the wingtips of a lead aircraft. In addition, from Japan, Dr. Akira Azuma, Professor Emeritus, Tokyo University, gave an overview of Japanese assessments of GPS-based air traffic control technologies. In addition, the program included a distributed panel discussion on a new multi-function transport satellite that was in planning in Japan at that time. Commentators were located both in Japan and at Stanford.

"The Present and Future of Electric Power Supply Systems" (9/10/97)

This topic reflected an impetus by the Japanese government to promote U.S. patterns of high-tech entrepreneurship through a major celebration of the 150th anniversary of the birth of Thomas Edison. In addition, the program of this conference saw the presentation of new Japanese government-sponsored R&D projects in electric power transmission technologies, even while the projects were still in formulation. Presenters from TEPIA included Mr. Kiyoshi Goto, General Manager, Research Evaluation Group, Development and Planning Division, Tokyo Electric Power Company (TEPCO), and Dr. Hiroshi Suzuki, Head, Electrical Power Technology Center, Mitsubishi Electric Corporation. From Stanford, Dr. James Statwick, Manager, North Central Region Power Delivery Group, Electric Power Research Institute (EPRI), provided an analysis of the effects of deregulation on electric power and related industries. In the videoconference, U.S., Japanese, and Thai experts discussed technological and regulatory issues. In addition, the Japanese speakers provided insights into new major research efforts underway in Japan to achieve greater efficiency in power distribution, e.g. by changing major distribution networks from AC to DC

electrical current. This development greatly would improve network efficiency by minimizing power loss, but it required the development of high-speed, high-power semiconductor switches to convert DC to AC at the local factory or substation level. This was an area of R&D in which major Japanese electronics firms had recently delivered excellent results. In addition to that topic, the Japan side provided information about new battery storage technologies aimed at allowing entire substations to stay on-line in emergencies until critical computer and other systems can be protected. The videoconference also dealt with new business models for pricing electricity and deregulation of the industry.

"Developing the Future Through Manufacturing" (10/08/97)

With the continuing stagnation of the Japanese economy (especially following the currency and financial crises of 1997), and also in light of Japanese concerns that it had lost its capacity for innovation, it became increasingly difficult to find topics that would simultaneously meet the interests of audiences in Japan and at Stanford. Consequently, for our final videoconference in the regular series with TEPIA, the USJTMC prepared a program that we presented to Japan real-time via TV conference, but that was discussed separately in a Stanford-only session immediately following the cutting of the TV link. This program included a keynote presentation by Prof. Fritz B. Prinz (Mechanical Engineering), Co-Director of the Stanford Integrated Manufacturing Association (SIMA), on "The Engineering Technology of Japan as Seen through the Eyes of the American Manufacturing Industry." This was followed by a distributed panel session on the topic "Changes in the Structure and Dynamics of Manufacturing Industries in Japan and the U.S.". In this panel, which was moderated by Dr. Dasher, there were two panelists at Stanford, namely Mr. Ken Katashiba, Special Advisor to the President, Fujitsu Limited, and Mr. Hirokazu Hashimoto, President, NEC Electronics, and three panelists at TEPIA: Dr. Konomu Matsui, Professor, Rikkyo University; Dr. Tadashi Sasaki, President and CEO, International Substrate Materials Lab; and Professor Hisayoshi Hashimoto, Saitama University. Although we discontinued regular TV conferenced programs with TEPIA following this event, we have maintained close relations with TEPIA, renting their facilities for our own programs on several occasions. This series of programs with TEPIA provided the USJTMC with unique insights into how to successfully manage the technologies for real-time TV conferencing between two public venues and also how to moderate question-and-answer and panel discussion formats in a way that would be successful simultaneously in both the U.S. and Japan.

This was no small accomplishment, as patterns of communication and expectations in regard to public programs differ greatly in the two countries.

From 1998, the USJTMC has cooperated with various other organizations in presenting public programs, some of which have incorporated TV conferencing. On 12/02/98, the USJTMC partnered with the University of Washington and the newly formed "Japan-U.S. Technology Transfer Forum," an association of university and industry licensing executives and other experts in Japan and the U.S., to present a TV conferenced program on "Technology Transfer and Venture Business in Japan." This session brought together a diverse group of speakers and audience attendees in a multipoint videoconference between Tokyo, the University of Washington, and Stanford. The discussion centered on the benefits and challenges to making Japanese technology more readily available for commercialization by U.S. start-up companies.

On 9/16/99, we partnered with The Japan Society of Northern California and the Kochi University of Technology to present a one-day conference at Stanford entitled "Where Is Japan in the Future of High Tech Business?" This conference attracted about 150 persons to Stanford for keynote presentations and panel sessions by Japanese and U.S. experts on Japanese business and also emerging technologies, such as ferro-electric memory (FeRAM) chips. Panelists included Lee Daniels, CEO of Titus Communications; Ray Tsuchiyama, Director of Worldwide Business Development, Tegic Communications (Tokyo); Gary Rieschel, Executive Managing Director, Softbank Technology Ventures; Hiroshi Menjo, Partner, The McKenna Group (high tech market consulting); and others. The final session in this conference was relayed by TV conferencing to the Kochi University of Technology; and included discussions between a Silicon Valley angel investor and a successful Japanese entrepreneur. The proceedings of this conference appear in the Appendix.

Public programs, including TV conferenced live events, have continued to be an important part of the USJTMC mission after the conclusion of the referenced grant. We continue to address topics that are relevant to the JITMT mission, e.g. "Microsystem commercialization trends in Japan" (a special seminar hosted at Stanford on 2/06/2001) as well as other emerging issues of importance to the S&T relationships between Japan and the U.S., e.g. mobile wireless networks and innovation systems in Japan. An archive of our recent public programs is found on our Internet website at http://fuji.stanford.edu/events/special_events.htm.

4.2 Publications and Presentations

During the grant term, the USJTMC disseminated the results of our activities via publications in scholarly journals and at academic conferences, in our *Update* newsletter, and via books of proceedings that we prepared and distributed. In addition, the USJTMC has received prominent press coverage in a number of newspapers and other press channels, both in the U.S. and in Japan. A list of publications appears in the Appendix, and copies of a number of our more important papers are likewise appended to this report. These included the case study by Professor Samuel Wood (Graduate School of Business) and USJTMC graduate student research assistant Gary Brown (Electrical Engineering) on laser diode commercialization by Sony Corp., and a paper about our *J Guide* Internet website by graduate student research.

Center personnel made a number of presentations at conferences during 1994-95. Graduate student research assistant Burton Lee (Dept. of Mechanical Engineering) spoke on "Accessing Japanese Science and Technology Information via the Internet," at the National Center for Manufacturing Sciences (NCMS) Workshop on Strategies and Methods for Accessing Japanese Technical Information, Orlando, Florida, May 1995. Burt Lee also made presentations at meetings of Japan-America societies in San Francisco and Seattle, Washington. Graduate research assistant Michael Bayle (Dept. of Computer Science) made presentations at a workshop on information technology applications held at MCC in Austin, Texas, in January 1995. As noted in Section 5, Center director Dasher chaired a panel session in the conference on U.S.-Japan Trade and Technology, presented in Washington, D.C., in October 1994 by the University of New Mexico Japan Center and the Japan Information Access Project.

4.3 Internet Websites

As noted in Section 3 "Research," the USJTMC developed, launched, and managed a number of major Internet websites dedicated to providing U.S. audiences with rapid, accurate, and useful access to Internet-based information about Japanese S&T and related topics. Of particular importance in evaluating the breadth of outreach that we achieved under the referenced grant are *Japan Window* (now operated by NTT) and our ongoing *J Guide* to Japan Information Resources.

Japan Window was released to the public in March 1995. Within the first week of its opening, this site was receiving approximately 20,000 accesses per day. This usage

increased to about 55,000 accesses per day by the end of that calendar year and about 80,000 accesses per day in 11/96, when we moved the project out of our research portfolio and spun it off to NTT for them to operate as a public service.

J Guide and other file directories on the USJTMC (including online archives of the proceedings of our seminar series and other public programs) have shown a more modest but still impressive rise in use. Early on, the USJTMC website was named "a crucial site for any U.S. firm dealing in Japan" (*PC Computing* "Roadmap of the Internet", 12/95), and later it received the accolade "best of the academic sources of Japanese S&T information" (*Computing Japan*, 4/98). Accesses to the USJTMC website (excluding *Japan Window* accesses) rose to about 10,000 per day by 12/95 and subsequently demonstrated a steady rise to 15,000 per day by 12/99. We have stabilized at about that level of accesses since the beginning of 2000. Based on the file architecture of our website (one discrete use of the website entails accesses to several different files therein) and also allowing for multiple uses by some individuals, we estimate that our Internet website (excluding *Japan Window*) was used by about 82,000 unique individuals during the term of the grant. If *Japan Window* is included, this number probably will grow by another 55,000 to 137,000 unique individuals. Uses of our Internet website by U.S. government personnel (".gov" and ".mil" domains) have consistently averaged about 9.8% of total accesses. The largest single user domain has been .com (approx. 33 %), which until recently was primarily made up of U.S. business users. In addition, we regularly received about 25% of our total accesses from Japan (.jp) addresses. Since our website is exclusively in English, we expect that quite a few of the Japan users are in fact Americans who live and work in that country.

A steady stream of inquiries, requests for further information about Japan, and requests for introductions to contacts in Japan further indicates the usefulness of our Internet outreach to the U.S. We have received such requests at a rate of about 15-20 each week. The requests have come from Congressional staffers, major U.S. company presidents, and some military and civilian government employees, along with many K-12 teachers, librarians, and people in our target categories of technology managers and researchers.

As noted elsewhere in this report, after the conclusion of the grant, the USJTMC continues to operate *J Guide* as the World Wide Web Virtual Library entry for "Japan" and to provide online archives of the presentation materials from our public programs

as some of our most important outreach activities. In addition, we continue to explore new technologies for outreach, including experiments from spring 2000 to use Internet II as a channel for real-time streaming of seminars and courses with partners in several East Asian countries. This is another indication of the success of the grant in creating an ongoing center of excellence.

5.0 Cooperation with Other JITMT Centers

The US-Japan Technology Management Center at Stanford cooperated actively with other JITMT grantees during the grant years. In addition to our regular informal communications with other JITMT centers for coordination of the timing of public events and information sharing, the following events are worthy of special note:

- USJTMC hosting of the JITMT Directors Meeting, Washington DC, 1/95
- Production of a 10-minute commercial quality video description of the JITMT program for directors to use with prospective corporate sponsors (1996)
- Organization of JITMT Directors Panel at the general meeting of the International Association for Management of Technology, 2/96
- Shared support with other Centers for lunchtime briefings in Washington DC on topics within the JITMT mission (1996-99)
- Participation by USJTMC Director Dasher in negotiations with MITI and JETRO toward the creation of the JITMT interns program sponsored by JETRO; Dasher's participation in "roadshows" to market the JITMT interns program to prospective Japanese host companies.
- Participation by USJTMC Director Dasher as a faculty facilitator, speaker, and panel moderator in the yearly AFOSR-sponsored summer workshops for U.S. students on internships in Japanese companies (1997-2000)

January 1995 JITMT Directors Meeting

In January 1995, the USJTMC arranged a two-day meeting in Washington DC of the directors of the all JITMT centers nationwide. For this meeting, we organized a

program of guest speakers to brief the directors on important issues. The program included the following highlights:

- Lt. Gen. Charles W. Dyke (U.S. Army, retired), now President of International Technology and Trade Associates (ITTA) led a discussion of the legislative context of the JITMT program and its relevance to U.S. defense readiness.
- Dr. Richard Sachs of the Congressional Research Service and Mr. Andrew Durant of SAMUELS International Associates discussed the needs of various organizations and groups in the U.S. government for Japan information and analysis. This discussion focused on analysis of scientific, technical, and business information and also dealt with possible activities by JITMT centers.
- Ms. April Burke of April Burke Associates and Mr. Keith Ausbrook, attorney at law with Collier, Shannon, Rill & Scott, discussed activities that are acceptable for U.S. government grantees in light of anti-lobbying regulations.
- Following the presentations and discussions, the JITMT directors discussed strategies to develop better connections to potential "users" of JITMT programs in DoD and gradually to develop outyear support for our programs from U.S. industry.
- JITMT directors also discussed the continuing negotiations with MITI and JETRO in regard to their possible support of JITMT center programs for U.S. students to intern in Japanese companies.

All of the JITMT centers sent representatives to the meeting. In addition, portions of the meeting were attended by guests from the NSF, the Department of State, Department of Commerce, and National Research Council Office of Japan Affairs. In addition, Dr. Koto White, program manager, observed the meeting. Representatives of MCC and the Japan Information Access Project, which are subcontractors to JITMT centers, likewise attended some sessions of the meeting. In arranging for this meeting, the USJTMC received assistance from the NSF, which provided the meeting facilities,

and the Japan Information Access Project, which provided us with recommendations for guest speakers.

5.1 Video Presentation of the JITMT Program

One item decided at the January 1995 directors meeting was the need for a videotape presentation of the JITMT program that would explain the missions of the centers and serve as a tool in the various centers' efforts to obtain outyear support. With approval of the concept by the directors, the USJTMC proposed and was awarded a supplementary grant modification from the AFOSR to produce this video and distribute it to other JITMT centers.

The USJTMC produced a ten-minute, commercial-quality video of the JITMT program. USJTMC Director Dasher and Outreach Coordinator Suzanne Orcutt wrote the script and storyboard, and served as executive producers of the video. After obtaining approval of the script from the JITMT directors, we worked in cooperation with a professional crew to film at the Massachusetts Institute of Technology, the University of Wisconsin, the University of California (Berkeley), and Stanford in order to gain footage that was representative of all JITMT program activities. We also filmed at corporate labs and factories to illustrate potential U.S. industry uses of the program. The video also included major endorsements of the JITMT program by Dr. John Mayo, President Emeritus of AT&T Bell Labs, and (then) Stanford Professor Michael Armacost, former U.S. ambassador to Japan and currently president, The Brookings Institute. We produced tailored copies for each JITMT center with its name and contact information. Finally, we distributed multiple copies of the videotape to each JITMT center and to our industry contacts in June 1995.

JITMT Panel at IAMOT Conference, Miami, Florida (2/96)

With funding from another supplementary modification to our JITMT grant, the USJTMC organized and presented a panel session that included several JITMT center directors at the meeting of the International Association for Management of Technology (IAMOT) in Miami, Florida, in February 1996. In this session, panel members described the JITMT program and its objectives, and they discussed the changing needs and goals for studies of Japanese technology management. Directors who served as panelists included Prof. Thomas Chapman (University of Wisconsin), Prof. Kaz Kawamura (Vanderbilt University), Prof. David Mowery (University of California, Berkeley), and Prof. John Shook (University of Michigan). In addition, Lt. General Charles W. Dyke

(U.S. Army, retired) also participated on the panel. Center director Dasher organized and moderated the session. About half of the attendees at the conference were from industry and half from the academic community. This session generated much interest in the JITMT program as well as the individual centers' activities; it was especially valuable in generating new contacts among strategic technology managers in U.S. companies outside the normal geographic reach of the respective centers.

5.2. Lunchtime Presentations in Washington, DC

The USJTMC jointly sponsored series of lunchtime briefings for the Washington, D.C., community, in cooperation with other JITMT centers. These programs, which were organized by the non-profit Japan Information Access Project, brought East Asia experts together with audiences of between 40 and 90 persons from various U.S. government agencies, Capitol Hill staff, and others. The sessions addressed critical security and defense preparedness topics, e.g. the following (all from autumn 1997):

- "Is There a Future in the U.S.-Japan Security Alliance?"
- "Japanese Aerospace: Defense Takes the Lead"
- "Japanese and Chinese Export Controls: A Backdoor Industrial Policy"
- "Japan's Banking Crisis: Domestic Politics, Global Repercussions, and the Potential for Meaningful Reforms"

These briefings were held at venues such as the Pentagon and downtown Washington sites that were within easy lunchtime walking distance for congressional and various department staff.

The USJTMC also cooperated fully in other JITMT-wide activities, including program reviews in Washington DC, and also in conferences and activities organized by other JITMT centers. USJTMC Director Dasher served as a speaker and panelist in the two *Workshops on Teaching Technical Japanese* organized by the University of Washington JITMT center in 1994 and 1996. and efforts to create a follow-on association of the centers after the conclusion of the JITMT grant program.

6.0 Recommendations

Our experiences during and after the term of the referenced grant indicate that there is a continuing need for public-sector support of programs such as JITMT. The university is an ideal setting for the study of emerging technology trends and technology management practices, and for conducting education and outreach to provide the current and future generation of U.S. researchers, technology managers, government funding program managers, executives, and others with a high-quality understanding of those emerging trends and options for responding to them. Nevertheless, such program goals cross over the boundaries of any single academic department. Moreover, such programs involve information access costs and the long-term development of relationships with industry that are not covered by typical university funding structures. As is the case with all externally funded university programs, such multidisciplinary centers will be responsive to the interests of their sponsors. In order to ensure that there are programs which address U.S. security and defense preparedness needs, the relevant departments of the U.S. government must take an active role in supporting competitive grant programs to address these interests.

Japan continues to be a critically important technology partner and competitor for the United States. Despite its stagnant economy and critical need for restructuring in certain industries, e.g. financial services and banking and also retail, major Japanese firms continue to move forward with world-class research in certain key technologies, e.g. optoelectronics, nanotechnologies, advanced materials, and—increasingly—biotech. Through the JITMT program, centers such as the USJTMC have demonstrated that it is possible to obtain cooperation and surprisingly candid, open sharing of information from such commercial sources of technology development in Japan. Moreover, Japan is making major strides to re-orient its university and national laboratory R&D base toward more practical, commercialization-friendly research goals. U.S. attitudes toward Japan over the last 100 years have demonstrated several cycles of ignorance followed by fear at the sudden emergence of a strong Japanese industry. In order to prevent future industry give-aways, as has arguably happened in the flat panel display industry (created in the U.S., but only successfully commercialized in Japan, and later predominated by Japan), the U.S. must place continued efforts into monitoring and analyzing emerging trends and R&D activities in Japan. Fortunately, the alliance between the United States and Japan is strong. In light of its importance, the comparative capabilities of each country need increasing attention and analysis.

Programs such as JITMT not only provide immediately useful information and insight; they will train the next generation of specialists to take the lead in such endeavors.

7.0 Appendices

Following are materials for reference in regard to our activities under the referenced grant. A detailed listing appears in the Table of Contents at the beginning of this report.